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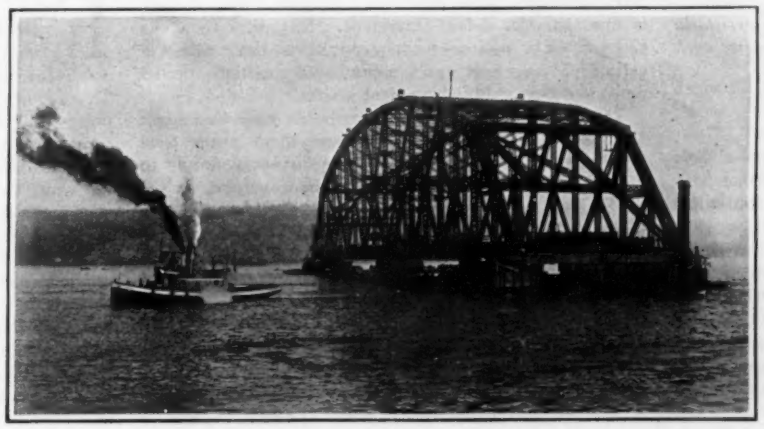
Building the Quebec Bridge

Second Attempt to Raise the 640-Foot Suspension Span Into Position, Successful

So absorbing is the interest excited by the great war that it takes an event of the first importance to direct the attention of the public to important events that are happening in the field of commercial and industrial enterprise.

An occasion of this kind has arisen in connection with the completion of the great cantilever bridge across the St. Lawrence at Quebec, where, during the week commencing September 16th, the engineers of the bridge successfully raised the 5,000-ton suspended span, which forms the completing link between the north and south shores of the St. Lawrence River.



Towing the center span into position

The Quebec Bridge forms the connecting line for several railroads between the United States and Canada. It carries two railroad tracks and two broad passenger footways. The bridge has the distinction of containing the longest single span (1,800 feet) of any existing bridge, the next longest spans being the two, each 1,710 feet in length, of the Forth Bridge, Scotland. With these great bridges may be compared the three famous suspension bridges across the East River, New York; the old Brooklyn Bridge of 1,595 feet span; the Manhattan Bridge of 1,475 feet, and the Williamsburg Bridge of 1,600 feet span.

In constructing the present bridge it was decided to build only the cantilevers by the overhang method, and to construct the center span separately, hoisting it into place when the cantilevers were completed. The center span, 88 feet wide, 110 feet deep and 640 feet in length, was built in the shallow water of a cove on the Quebec side of the river a few miles to the west of that city, and a few miles below the bridge site.

The first attempt to build the bridge resulted in disastrous failure. It was erected by overhang, and not only was each cantilever built by that system but the central span as well. When the half of the bridge on the southerly side of the river was nearing completion it collapsed under its own weight, with the loss of 82 of the bridge crew who were at work on the structure. The failure was due to the buckling of the bottom chord of the shore arm of the cantilever. This member (in the first panel of the shore arm adjoining the tower) was composed of four vertical plate-steel diaphragms, five feet in depth, each of which consisted of several plates stitch-riveted. These diaphragms were placed at equal distances from each other and the width of the member as thus assembled was about five feet over all. The buckling was due to the fact that these diaphragms were insufficiently maintained in place and connected to each other; for they were held by light lattice angles, measuring only about 3½ by 4½ inches on the side. Under the heavy compressive load of about 9,000 tons these angles failed, the rivets connecting them to the diaphragms shearing off and permitting the whole member to crumple up under the excessive load.

As a consequence of this disaster and the findings of a special board appointed to investigate the matter, an entirely new bridge of much greater weight and strength was designed and partially erected. About a year ago, an attempt was made to hoist the central span into position; but when the hoisting had been in progress only a short while, and when the span had been lifted only a few feet, it slipped off the lifting girder, by which it was being temporarily carried, crumpled up, and fell to the bottom of the St. Lawrence. Immediate announcement was made that a new span would be built and that within a year the loss would be made good. The second attempt was crowned with complete success. The span was floated into position on Monday Sept. 16th, and on the following Thursday the span had reached its final level, 150 above the river, and was pinned in place.

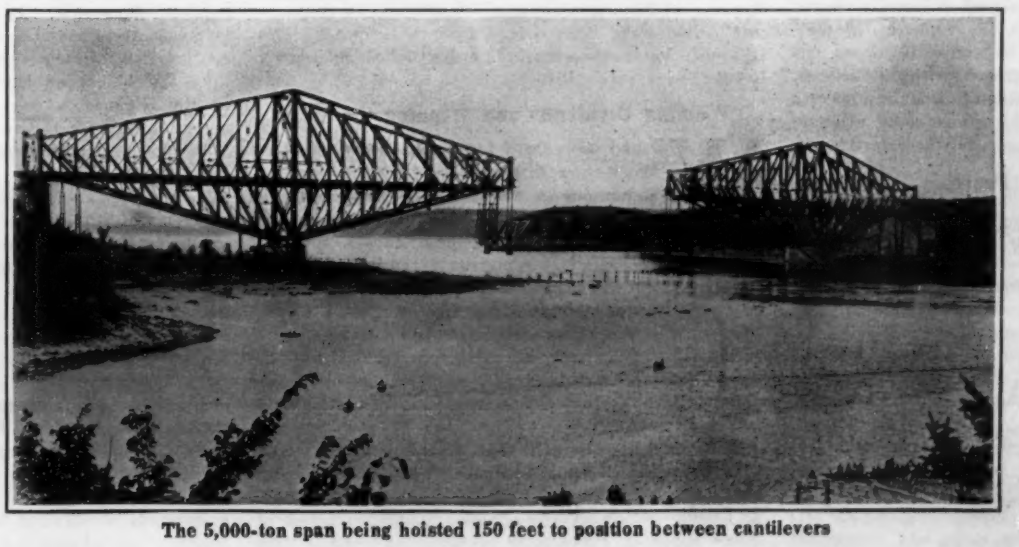
Span in position, chains attached for hoisting at high tide

The present span is an exact duplicate of the one which was lost, and the same method was used erecting it upon scows and towing it into position below the bridge. Only in some details of the lifting mechanism have such changes been made as to prevent a repetition of the disaster of last year.

The span was erected upon six large scows which were placed beneath three end panel points at each end of the span. The scows were 165 feet long, 32½ feet wide, and their draft was 11¼ feet. Valves were provided at the bottom of the scows to allow the water to enter during construction of the span. On the day for closing the bridge the valves were shut and the 5,000-ton structure was floated out on its scows. It was towed into place beneath and at the center of the bridge by several powerful tugs. To hold the span in exact position while the lifting chains took hold of it, a "mooring truss" had been built at each end of each cantilever and was hung vertically from the bottom chord. Steel mooring cables 1½ inches in size, led from the bottom of the mooring trusses to the ends of the central span. By means of powerful tackles the span was brought in line with the bridge and vertically below it.

The span was lifted by means of hanger chains, attached to the cantilever, there being four strings of massive steel links to each chain. Each link was made up of two steel plates, 1⅛ inch thick by 30 inches deep. At their lower ends these chains were connected to massive supporting girders, 25 feet in length, there being one such girder at each corner of the truss—or four in all; and upon these girders the span rested while it was being raised into position. At their upper ends the lifting chains were made fast to similar supporting girders arranged in pairs, on the ends of the cantilevers, one above the other, with a pair of 1,000-ton hydraulic lifting jacks interposed between each pair. In the lifting operations of last year, there were interposed between the bottom of the truss and the lifting girders cast-steel rocker joints, which were placed there to permit of a certain amount of turning movement about the transverse and longitudinal axes of the bearings.

The details of the lifting operations were as follows: Each operation of the jacks lifted the span two feet. During the lifting, 12-inch pins engaged the lifting chain through diaphragms built in the upper jacking girders. At the end of the 2-foot stroke, 12-inch pins were driven through the diaphragms in the lower jacking girders to engage the hanger chains. When this work had been accomplished the jacks and upper girders were lowered and the jacks were then operated through another 2-foot lift.



The 5,000-ton span being hoisted 150 feet to position between cantilevers

Last year the span was towed to its position on September 11th, and the hoisting commenced in the presence of a vast concourse of invited guests and the general public. When the span had been lifted a few

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The Liberty Motor

AMERICAN manufacturing methods have always been a source of astonishment to Europeans—an astonishment not unmixed with contempt; for the American product is usually designed for work rather than appearance, and the lack of finish in some of our machines has led foreign critics to believe that our manufacturers have absolutely no esthetic sense. But what our product lacks in beauty it makes up in ruggedness. We realize fully the importance of standardization, and must design our machines for manufacture in quantity in order to compete with cheap labor abroad.

When we entered the war it was realized that the enormous manufacturing facilities of the United States would be of greatest aid to our Allies, and we were urged to devote ourselves particularly to aeronautics, because in this field our manufacturing resources could be used to good advantage, and men could be trained for aviation service in a minimum of time. Unfortunately, although the United States is the native home of the aeroplane, we are sadly behind Europe in the development of this machine. It was realized at the outset that we must produce an engine of American make and American design to suit American methods of manufacture. It would not do for us to copy European engines, because they would not be adapted to the system of manufacture in which we have specialized. Therefore, a group of experts in the design of high speed engines was assembled and instructed to produce an American motor. All the designs of European engines and American engines were placed at the disposal of these men. Their object was not to invent a new motor, but merely to pick out the best of what had been fully tried out in actual field service, and to assemble these features into a single motor which could be turned out quickly and in large quantity.

Although it had been known that work on a special engine was under way we were all astonished to learn a few days ago, that the machine had actually been produced and tried out under most exacting conditions with perfect success. In so short a time was this engine developed that engineers were inclined to feel somewhat skeptical of the real worth of the machine. However, the motor involves nothing new in principle, but is merely a composite of well tried mechanism designed particularly for American methods of quantity production. The fact that this motor was taken to the top of Pike's Peak in order that it might be tested in the rarified atmosphere of high altitudes shows how rigid were the tests applied to it. It has proved its worth not only on the ground, but in actual flying conditions, and we are assured that it can now be produced in large quantity, and as fast as needed. When the "Liberty Motor" makes its appearance abroad no doubt European engineers will look askance at some of its rough surfaces. They will not be able to understand how we can leave a brazed joint unfiled; but it is the service of the machine that will tell. It was designed primarily as a work horse.

No German Peace

GERMAN agents are now conducting a systematic peace propaganda, alike in Germany, in neutral countries, and so far as they are able among the enemy nations. When this effort fails, as their masters know it must, these masters will proclaim loudly, as they have proclaimed many times before:

"Behold! We are willing to make peace, but our wicked foes will have none of it. On them therefore rests the responsibility for the continuation of this awful conflict."

Nothing could offer a spectacle of more complete retribution than this plight in which Prussian Junkerdom now finds itself. In July, 1914, Europe was at peace—and, save for Germany alone, willing and anxious to remain at peace, willing to make any reasonable sacrifice to that end. But Germany did not want and would not have peace, save on terms which would permit her to feed the smaller nations to the dogs (Austria's note to Serbia, and Germany to the powers regarding Austria and Serbia), to carry on active preparations for hostilities while the only neighbor against whom they could by any possibility be directed was to remain deliberately defenceless (the ultimatum upon the Russian mobilization), and to remain in possession of supreme power on land while the possessor of supreme sea-power was to tie her own hands with an agreement not to avail herself of that power (the chatter about freedom of the seas). At the time of which we speak, Germany responded to the appeals of the present Allies for peace with the harsh ultimatum: "There shall be no peace which does not leave Germany master of the world."

The war which she thrust upon the world, thanks to the splendid resistance of Belgium and France to the first terrific onslaught, has back-fired in Germany's face. She now finds herself in a position where victory is unattainable, defeat imminent. Naturally then she seeks a draw, and uses every means to bring about a calling off of her foes; and the number of good-intentioned persons deceived by her present attitude is legion.

To such persons we would bring home again and again the fact that there can be no permanent peace with Germany as now constituted. We do not presume to dictate to Germany how she shall be governed, as the accusation runs. We do claim the right to do with Germany somewhat as Germany did with France in 1871—to say "with this government of yours we can make no peace; the war will continue until you have a government with which we can treat on a basis of mutual confidence."

When Germany possessed the power of dictating between war and peace, she chose war, and forced war upon the world. Nor was the war of her forcing such a war as had ever before been known. It was a war in which one neighbor was wantonly attacked because she refused to bind herself not to join Germany's foes, another because she would not join Germany against those foes. It was a war destined to confer immortality upon the phrases "von heute wird kein Gefangener" and "spurlos versenkt," upon the names of Cavell and Fryatt. But now the power of dictating between war and peace has passed from Germany to the United States and our Allies, and as we look back upon July and August, 1914, we can only say to Germany:

"You made the war upon your own terms, at your own time, and enforced it upon an unwilling world. Now the world will make peace with you upon its own terms and at its own time, and if necessary force terms and time upon you."

In taking this position, we are not actuated by any motives of blind rage or desire for revenge. We act merely in self defense. It is simply that we know why Germany, as now constituted, wants peace now. More than one of her influential men, in a moment of undue recklessness, has made this plain to the whole world, has explicitly stated that he regards the much-sought-for peace as merely a period of preparation "for the next war." In their secret councils, who can doubt that Germany's magnates bring this point forward with the utmost candor? They thought, three years ago, that they had worked out a procedure for overrunning the world. They find that they were mistaken; so they have revised their formula, and are sure that this time they have it right. But the "idiotic Yankees" (von Papen) who are the prospective victims of their program for world conquest refuse, for some reason which the German mind cannot fathom, to afford Germany the interval of peace necessary for the initiation of her renewed attack upon the world's liberties. And on grounds of legitimate self defense, this refusal will continue until the consciousness that the world is not by divine proclamation Germany's footstool is drummed into the Kaiser and his captains, until all thought of a "next war" shall have been driven from their heads. We will push this war to a finish, in order that we shall never have a "next war."

Winning Dividends and Winning the War

WE had occasion a few weeks ago to deplore the lack of interest shown by the shipping companies in any form of anti-submarine protection which involved trouble or expense for the shipowners, who are exhibiting these days a spirit of abysmal conservatism. American inventive and constructive talent has been asked to bend itself to the task of suppressing or at least curtailing the ravages of the submarine, and as a people we have risen enthusiastically to the call. Not merely the intelligent layman, but the most gifted and distinguished men in science and engineering have applied themselves and their time and talents to the task.

One would have thought that the shipping men would have given these efforts their most friendly and earnest coöperation; but nothing of the kind has happened. Any device which involves change, expense, reduction of cargo space, or curtailment of speed, is received with chilly reserve and not infrequently with ridicule or positive irritation. Anything which will reduce, in ever so small degree, the value of a ship as a dividend-earning proposition after the war, is ruled out of court as visionary and impractical. The employment of obviously useful devices, such as camouflage, smoke bombs and the sailing of a zig-zag course, has to be forced upon the shipowners by Government penalties.

"I can better afford to lose one ship in twelve than to embody anti-submarine construction in my fleet," says the owner. "The idea of offering a bonus for torpedo-proof construction does not interest us," said a high official of one of the marine insurance companies, "for our rates increase with the increase of sinkings."

Is it possible that the shipping people are more concerned with winning dividends than they are with winning the war?

The Executive and the Engineer

FIFTY years ago—to a great extent even twenty years ago—the engineer was merely the man who went out into the uncharted wilderness and laid down the trail along which civilization was to follow. This remark possesses ambiguous significance, and purposely so. The engineer was indeed a pioneer in a double sense. On the one hand he was to be seen pushing forward into the untravelled portions of the material sphere on which we live, laying down railroads across the wilderness of plain and mountain, opening up great mines in the heart of undeveloped country, cutting down the mountains to let the water through or throwing up huge obstacles to keep it in and make it serve his ends. On the other side of the picture he stood as the pioneer of thought, doing things which had never been done before, searching out facts which had never been known before, always asking, asking, asking, and finding the answer—adding something every day to the accumulating store of human knowledge. But he was never complete master of his own activities; and the things which he made and found immediately passed out of his hands upon becoming part of the common heritage of mankind.

In those days, when the executive and the administrator were confronted with a decision to be made that involved engineering values, they called in the engineer as from a world apart and bought his expert knowledge. Fundamentally this system was an uneconomical one. The engineer and the executive did not possess the same points of view, did not even have the ability properly to reconcile their points of view. Accordingly, decisions were far too often made upon grounds of financial expediency, with engineering values only considered in so far as they demonstrated the possibility of the course upon which executives had set their hearts from the beginning. The engineer had no appeal from and little influence with the executive.

This, of course was bad; not so fatal as the French blunder of the Panama Canal, but quite as abstractly bad as this one outstanding instance where engineering considerations came first and last, with executive and administrative values thrown recklessly into the discard. But it was not to be avoided. The bald facts were that executive and engineer were separated by a broad gulf, each knowing little and caring less about the problems and procedures of the other.

The twentieth century has seen this fault substantially corrected. More and more we have realized the absurdity of putting a man in charge of production because he is a wizard at selling bonds, or of supposing it possible for an executive to hire and fire men to supervise operations of which he is profoundly ignorant. More and more we have seen that the executive and engineering fields are not fundamentally distinct at all, but that the principles and practice of each have a direct bearing upon the problems of the other. The gulf between executive and engineer has disappeared. It is not merely that they have reconciled divergent habits of thought and learned coöperation. They have gone further than that. Our executives have become engineers, our engineers executives. The executive who cannot pass sound judgment upon a technical problem is today as much out of place as the engineer who cannot handle men. Both are anachronisms; for the two professions have merged.

It appears that the war is to write the last chapter in the story of this process. Under the whip lash of necessity, engineers are being forced to turn their mind to the problems of administration as never before, executives are being driven to engineering principles to meet the difficulties with which they find themselves confronted. In harmony with this, our engineering schools are demanding, as never before, of candidates for admission and for graduation a presentable personality and the ability to do, as well as to plan and calculate; and in general, wherever a man is engaged in the work of the engineer or the administrator, he finds this double standard set up for him to conform with. Perhaps it is not going too far to anticipate that among the good things which the war has forced us to accept, one which we will be least willing to give up when its retention is no longer a question of survival is this complete correlation of executive and engineering activities.

Electricity

Radiotelegraphy in Italy.—It is announced that the Italian government proposes to construct a powerful wireless station in central Italy. The station is being planned on a new system, and it is anticipated that it will soon be available for the transmission of news.

An Electric Recorder for Boiler Water.—The task of the power plant engineer is materially lightened by an electric recorder which records the level of the boiler water at all times. This instrument indicates where the water is and where it has been, and the time in each instance. It is provided with high and low alarms in the form of lights and bells. A light burns continuously when the boiler water is on the economical line.

The Periscope in the Power Plant.—In a Western power plant the attendants are making clever use of the periscope idea. In order to read the temperature of the oil in transformers, it has been necessary in the past to use a step-ladder to reach the thermometer mounted at the top of each unit. By using a simple periscope on each transformer, it is now possible for the attendants to read the thermometer scale, which is illuminated by a lamp suspended near it, from the floor.

The Largest Duplex Submarine Telephone Cable in existence was recently laid between Keansburg, N. J., and Annadale, Staten Island, N. Y. In all, the cable measures 28,248 feet, and is of the double-armored type containing 74 pairs of No. 16 wire and 12 pairs of No. 22 wire. Loading pots have been installed at five points, the splices being tested for water tightness by dry air pumped into the sleeves before filling with paraffine. The locations of the pots are indicated by spar buoys.

Wireless Air Raid Warning.—The *Daily Chronicle* reports that Mr. Thorp Hincks has devised apparatus for giving warning of impending air raids. It is claimed to be especially applicable to factories and public buildings. An electric resonator is placed on the roof, and on the sound of a given pitch being produced, the resonator causes a bell to ring in the building until it is stopped. It is said that large areas, such for instance as the whole of a city, can be simultaneously and instantaneously warned.

Army Food to be Cooked by Electricity.—A leading manufacturer of electric heating devices has recently submitted an electric oven to the War Department for possible adoption for Army cooking. This oven is designed to take care of baking, boiling and frying operations necessary in the feeding of about 150 men. It is unique in that it is the first oven to be designed to perform all of these various cooking operations at one time. The hot-plate which is bracketed to the oven will accommodate the standard United States Army coffee receptacle. The oven is rated at 15 kilowatts.

The Thermophone as a Precision Source of Sound.—Writing recently in the *Physical Review*, Messrs. H. D. Arnold and I. B. Crandall tell how they found that the thermophone, together with a suitable supply of alternating current, can be used very conveniently as a precision source of sound energy. On account of the fact that the published material on this electrical-acoustic effect is largely of a qualitative character, it has been necessary to work out a quantitative theory, and it is the purpose of this paper to give the theory and show how the instrument can be adapted to acoustic measurements.

A Portable Lighting Outfit.—Although primarily intended for manhole work where space is usually at a premium, a portable lighting outfit recently introduced by a leading storage battery manufacturer appears to be ideal for all classes of work where a light is required. The outfit consists of five storage cells completely assembled in a tray, fully charged and ready for immediate service, together with two properly guarded 12-candle-power lamps with reflectors and with 11-foot leads. One of the lamps can be used for 20 hours on one complete charge of the battery, constantly burning. Running together they will burn for 10 hours. The cells are contained in a small steel box. Complete, the outfit weighs 40 pounds.

A Camouflaged Show Case Light.—Having the appearance of a display stand but containing in its base an electric-light bulb and reflector, a newly-introduced device represents a real and successful attempt at camouflage in electric illumination. The new device is a portable one and consists of three distinct parts: first, a nickel-finished reflector bowl, 10 inches in diameter, which contains a 75-watt gas-filled tungsten lamp and which serves as the base; a plate-glass shelf, mounted on the base and adapted to the display of goods; and an upright card rack surmounting the shelf, which can be used for displaying prices, or other reading matter. The reflector bowl or base is opened at the bottom, so that when the device is placed on the glass top of a show case the light is thrown downward, illuminating the goods below. Since no lamp is visible the effect is at once mysterious and pleasing.

Science

A New Scientific Society in Switzerland.—Members of the Société Helvétique des Sciences Naturelles interested in geophysics, meteorology and astronomy have organized an independent section devoted to those branches of science, to be known as the Société Suisse de Géophysique, Météorologie et Astronomie. The initial meeting was held at Schuls in August, 1916.

Correspondence Courses in Agriculture are offered by the Union of Agricultural Syndicates of Southeastern France. At the beginning of each month from October to April the pupil receives instructions as to a course of reading, the management of a small experimental plot, the carrying out of simple experiments, visits to neighboring farms, etc. The Union has appointed a number of "monitors" to supervise the work of pupils in their several neighborhoods. The pupils prepare monthly examination papers and render monthly reports on their work.

A Practical Application of Anthropology is noted in the last annual report of the U. S. National Museum. Dr. Ales Hrdlicka, curator of physical anthropology, was employed for three months by the Department of Justice in making an examination of Chippewa Indians for the purpose of determining which should be classed as full-bloods. To prepare himself for this work he spent a month among the Sioux Indians of the Dakotas and among such of the Chippewa as it seemed especially important to visit beforehand. After these preliminary studies the actual work of determining the blood status of the Chippewa was begun, and results were reached with promptness and certainty. About 1,200 Indians of all ages were examined, and on 696 of these detailed reports were made to the department. The undertaking was noteworthy from a scientific point of view because it definitely puts on record the present racial status of the Chippewa. This people, which is historically important and still very numerous, will before long be composed entirely of mixed bloods, and will no longer afford the material for such investigations as those just made by Dr. Hrdlicka.

Arsenic in Hops.—A long-standing complaint on the part of European importers of American hops is that such hops frequently contain traces of arsenic. In many cases shipments have been rejected for this reason resulting in serious loss to the American producer. Some years ago the U. S. Bureau of Plant Industry suggested that the use of impure sulfur in the process of bleaching was responsible for the presence of arsenic, but many growers did not accept this view. Other suggested sources of arsenic were the soil, commercial fertilizers and materials used in spraying. In view of the uncertainty on this subject a thorough investigation has recently been carried out by the Bureau of Plant Industry and the Bureau of Chemistry in the hop-growing sections of Oregon Samples of hops dried in the sun, without the use of sulfur were found to contain practically no arsenic. The spraying materials in general use such as solutions of whale-oil soap and quassia or nicotin sulphate were found not to be responsible for the contamination. On the other hand the sulfur used by the growers was generally contaminated with arsenic, many samples containing over 100 parts of As^2O_3 per million of sulfur. Hence it is practically certain that impure sulfur is the only important cause of the trouble.

Effects of Climate on Soils.—Messrs. Lipman and Waynick, of the University of California, have published an account of experiments on this subject which have been conducted by the U. S. Department of Agriculture in collaboration with the experiment stations of Kansas and California. In 1908 two blocks of soil, five feet square and three feet deep, were moved from each station (viz, in Kansas, California and Maryland) to the other two stations, and placed in position as nearly as possible in the original soil layers. Near each of these a block of soil of the same size was dug up and replaced, and a check plot of undisturbed soil was also set aside. Seven years later all these samples were submitted to careful physical, chemical and bacteriological examination. Striking changes are reported in the appearance of the transported soils. The Kansas and Maryland soils in California have become of a much deeper reddish color, while samples of loam from Kansas and California have changed in Maryland to a light or yellowish clay. The soils taken to California have increased their hygroscopic coefficient, their moisture equivalent and their wilting point. Bacterial examination shows that, in general, the numbers of bacteria increase when arid soils are put under more humid conditions, and decrease when humid soils are brought to a drier climate. The destruction of cellulose varies inversely with the bacterial numbers. Chemical analyses show marked changes in the acid soluble constituents of the soils, due to climatic effects. The general conclusion is that profound changes, chemical and otherwise, take place in a soil when it is moved from a dry to humid climate or *vice versa*.

Invention

Making a Tractor Out of the Automobile.—While there have been numerous devices introduced in the past for changing the automobile from a pleasure car to a practical tractor, Harry D. Hapeman of La Grange, Ill., has actually developed a tractor attachment of the endless link-belt type. In his patent specifications he proposes the use of large wheels in front, and an endless link-belt unit which is driven from the rear axle.

An Aid to Selling Veilings.—By means of the simple and inexpensive device recently introduced by a Ridgewood, N. J., inventor, George T. Eager, it is possible for the purchaser of veilings to view herself wearing such goods without even taking the bother of removing them from the bolt. How this is done is as follows: A slide is inserted in a bolt of goods in such a manner that through an aperture it is possible to view one's self in a mirror in front of which is the veiling. Below this mirror the goods may be examined against a background, making the two effects available at one time.

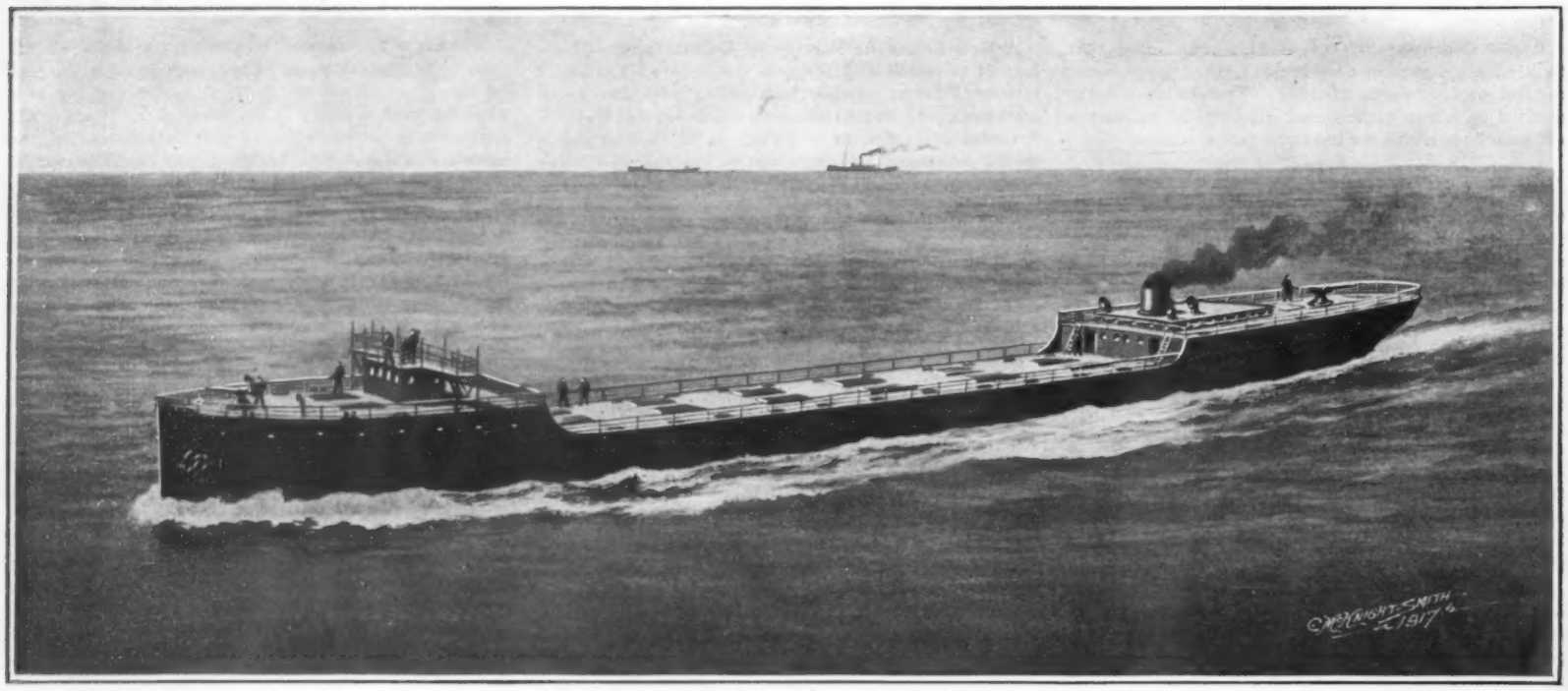
A Device for Preparing Infusions.—From far-off Funchal in the Madeira Islands, Antonio Izidro Gonsalves has applied for a United States patent on a novel cup for preparing infusions. His device consists of two cups fitting one within the other, the outer one being provided with a handle and the inner one with numerous perforations. At the botton of the outer cup is placed the matter to be infused, following which the inner cup is pressed into place, and held there by friction. Hot water or other liquid can then be poured into the inner cup, and the infused liquid poured out while the residue is retained in the outer receptacle.

Block Sugar Dispenser.—In certain New York restaurants there has recently appeared an ingenious type of block sugar dispenser which is bound to appeal to the restaurateur and patron alike. Consisting of a main body and a cap which is held in place by a threaded rod and nut, the dispenser holds the blocks of sugar in three vertical slots. The lower-most block in each slot rests on two ledges, so that it is exposed at the front and underneath, permitting its removal with one's finger. As the block is removed the next one falls into place. The dispenser is made of clear glass, so that the blocks of sugar are always in plain view. The user of the sugar is assured a clean piece each time, and there is a tendency to reduce the amount of sugar wasted.

Trench Weapons Which Stab and Shoot.—It is evident that inventors are hard at work on the problem of evolving weapons suitable for the peculiar conditions in trench warfare. Pawel Pys of Detroit, Mich., for example, has patented a weapon which consists of a short sword or bayonet with a handle that also forms the handle of an automatic pistol. Thus the user of this weapon can elect to stab the enemy when engaged in close fighting, or shoot him. With practically the same idea in mind, Joe J. Wigiert of Bremond, Texas, has patented a sword which carries a pistol on the blade, just in front of the usual handle. In this case the pistol is separate from the sword handle, but has the advantage of firing in the same direction as the blade is pointing.

Making the Regular Typewriter Noiseless.—Several patents have been granted to Nils H. Anderson of Middletown, Conn., on various methods of making the conventional typewriter noiseless by means of novel platen construction. One of the methods consists of a cylindrical covering having a continuous outer working surface, a laminated core formed of metal disks and interposed sound-deadening material within and backing the covering, heads at the end of the core, and means extending through the core and heads for holding the parts together. Another method calls for the use of an inner tubular core having an annular groove forming a pocket, an outer tube of relatively hard material covering the inner tube, a sheet of insulating material wound upon the inner core and within the pocket, a rubber covering upon the outer hard tube, end caps, screws for attachment of the end caps to the core, and insulating washers between the screws and end caps.

Twisting Eggs in Paper to Mail Them.—The safe delivery of eggs to be sent through the mail will be insured and their period of freshness prolonged at the same time by the use of a new system which has recently been patented and is now being called to the attention of egg dealers and shippers. The patent is on a machine which wraps the eggs in a long strip of paper, the eggs being entirely covered by the paper which is twisted about them, making them resemble a length of sausages more than anything else. The paper in which they have been encased has been dampened, and in this condition the eggs are draped around a collapsible wire frame. As the paper dries it becomes taut, and the eggs are securely held between the arms of the frame. When they are placed in a box for shipment they are supported so that they cannot come in contact with each other nor the box, and they are thus enabled to withstand a rough experience which would be disastrous under ordinary conditions. The frames are made in one dozen and crate sizes.



Torpedo-proof ship designed for the submarine zone

The Submarine Problem—XVI.

Protection, Internal to the Ship, Against the Torpedo

ONCE the torpedo is on its way at 30 to 40 knots against a ship, the latter must depend for protection either upon her helm, or upon some form of protection, internal or external to the ship. In previous chapters of this Series we have shown several methods of external protection, such as nets, steel plates, etc., placed at some distance from the ship and towed independently, or by the ship itself.

Internal protection is built integral with the ship, and consists, broadly, of elaborate compartmental subdivision. Last week we illustrated a ship designed with such protection, and in this issue we show yet another study of the same problem.

The present design is by Mr. Hudson Maxim, and we direct attention to an article by him in the SCIENTIFIC AMERICAN under date of June 9th, 1917, in which he described and explained at considerable length the action of the high explosive blast of a torpedo-warhead against the hull of a ship, and showed with illustrations how a practical torpedo-proof ship could be built.

The design herewith shown is an improvement upon the design there illustrated and described.

That portion of a ship's hull in danger of being struck by torpedoes is within a zone or belt about the ship, from 15 to 20 feet in width, extending from the bottom of the ship up to within four or five feet of the load waterline. When the warhead of a torpedo explodes against a ship's hull of the usual construction, the masses of metal constituting the hull-wall of the ship are broken into fragments and hurled with great violence in through the ship's compartments, which fragments, together with the blast of the explosion gases themselves, perforate, shatter and disrupt the water-tight compartments and bulkheads in their path. In the case of the *Gulflight* these fragments were hurled clear through the ship and out at the other side.

It would be impossible to place a wall of metal in the under-water hull of a ship massive enough and strong enough to protect it against such action of the explosive blast of a torpedo warhead; because, at the instant of detonation, the mass of high explosive is powerful enough to shatter everything in its immediate vicinity. Consequently, it is desirable to place as small masses of metal as possible in that portion of the ship's hull which constitutes the danger zone or danger space, so as to minimize the destructive effect of fragments driven in through the ship by the explosion. In the present design the outer hull-wall C of the ship around the danger zone is made as thin and light as practicable, while two main longitudinal bulkheads, A, A, one on each side of the ship and running the entire length of the ship, are made sufficiently strong in conjunction with connected structure, to give the ship the required staunchness and longitudinal stability, and also sufficiently strong completely to resist the residual force of the explosive blast.

These two main, longitudinal bulkheads preferably consist of a series of arches springing from interposed vertical beams and extending vertically from the usual double bottom to the main deck, with the concave of the arches directed toward the outer hull. This construction forms a comparatively thin and yet sufficiently strong bulkhead, saves space, and makes the walls more resistant for a given weight of metal to gas pressure brought against it in that the pressure is resisted more by the tensile strength of the metal and less by its mass and stiffness.

Strong steel brackets, B and B′, are riveted to the outer surface of the two bulkheads every 24 feet or so, extending outward to the outer hull, C, of the ship, the upper bracket, B, aiding to support the main deck, D, and to brace the upper portion of the outer hull, the lower bracket B′ extending from the outer hull down to the bottom of the ship; while the other brackets E extend from the brackets B′ to the outer side at the turn of the bilge, to stiffen and hold the bottom as well as to aid the first-named brackets in stiffening and supporting the transverse bulkheads and also the main longitudinal walls and to enable them to resist any amount of gas pressure to which they are likely to be subjected.

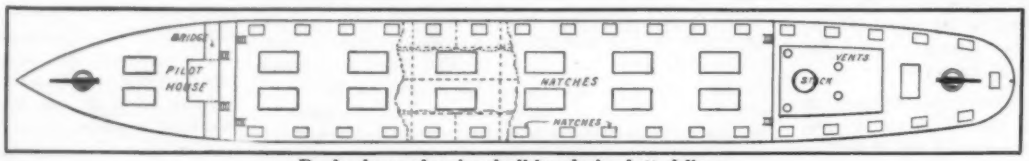
Both the upper and the lower brackets B, and E, at or near the outer wall or hull of the ship are connected by strong longitudinal steel beams or girders, F, F′, F². To these steel beams or girders and other lighter framing *f*, the outer hull, C, of the ship may be fastened in any suitable manner.

Each of the large steel brackets, B, B′, and E, is also made to constitute a part of a support for the web of a transverse watertight wall or bulkhead G, so that a watertight compartment, T, is constituted between the brackets and the outer wall, and each of the main inner walls or bulkheads. Each of these watertight compartments is provided with a hatchway or trap-door, H, through the deck, shutting watertight, but capable of being thrown open to provide a large vent for the escape upward into the atmosphere of the products of combustion entering the compartment from an explosive compound exploded against the outer wall of the ship.

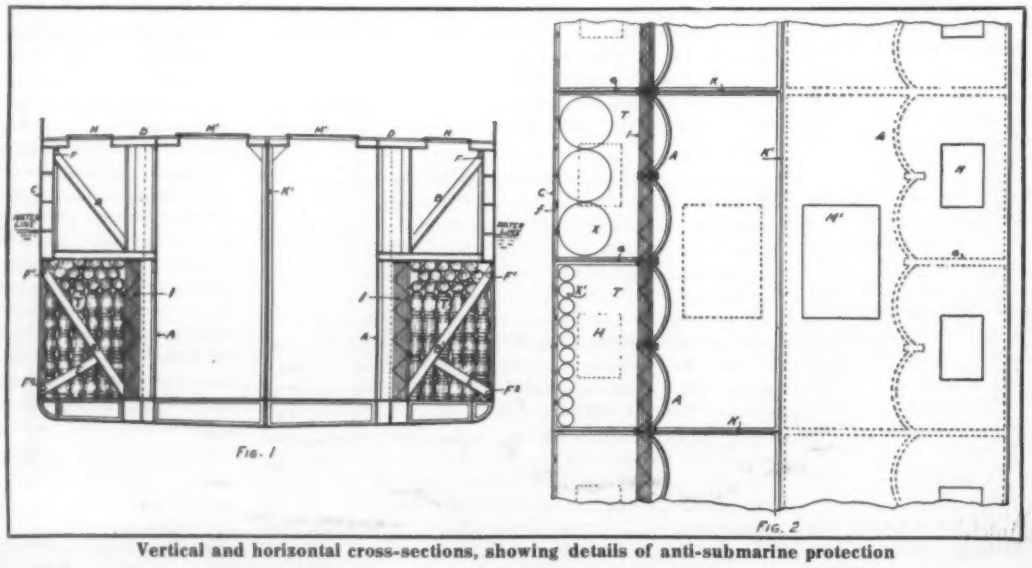
Immediately upon the outer face of the longitudinal bulkhead and built into the same and constituting an integral part thereof, is a strong steel screen, I, made of round rods, from three-quarters of an inch to an inch in diameter, the longitudinal rods being drawn taut between I-beams forming a part of the longitudinal bulkhead, and the vertical rods being drawn taut between strong beams, supports, or girders. The steel rods of the screen, I, thus intimately combined with and constituting a part of the inner main longitudinal wall or bulkhead, greatly strengthen it.

In this way no extra weight is imposed upon the ship and no more space is taken up by the wall than would be occupied by walls of usual construction if made equally strong, and the screen would constitute no inconvenience or disadvantage in time of peace.

The watertight compartments, T, between the outside hull or wall of the ship and the steel screen, as already indicated, should be filled with a suitable heat-absorbing buffer cargo, such as molasses, waters, oil, beer, liquors and other liquids, or apples, potatoes and other vegetables containing a large percentage of water, so



Deck plans, showing bulkheads in dotted lines



Vertical and horizontal cross-sections, showing details of anti-submarine protection

that in the event of the ship being struck by a torpedo, such cargo would serve as a buffer and would also be pulverized by the blast and thrown against the steel screen or barrier and thereby caused to absorb a large proportion of the heat from the gases, with great reduction of their volume and velocity. But no freight should be piled or placed in the space above the steel screen, because such space must be utilized for the free passage of the products of combustion upward through the hatchway vents in the deck into the atmosphere.

Thin steel cylinders, such as X, may be placed in the space between the outer hull-wall of the ship and the steel screen, having a diameter substantially equal to that of the width of the space, and a height substantially equal to that of the steel screen, into which cylinders may be placed the heat-absorbing buffer cargo abovementioned, and if oil fuel be employed for driving the ship, then oil may be carried in these cylinders for that purpose, to be replaced by water as used, and on the return trip, when no cargo is available for the heat-absorbing buffer purpose, then the cylinders may be filled with water, as already described.

These steel cylinders, or a portion of them, may either be fixed permanently in the said space, or they may be made detachable so as readily to be removed, to be charged with freight and returned to their positions.

(*Continued on page 233*)

Signalling To and From Aircraft by Means of Miniature Searchlights

TO ensure communication between aircraft and the ground, the French army has recently introduced a novel form of miniature searchlight, operated by electricity and equipped with a telescope. When in use the searchlight is held in the hands of the operator so as to bring the telescope into sighting position. The searchlight is aimed at the aircraft with which communication is to be established and maintained, and the operator then sends the messages by means of a tapping key on the side, causing long and short flashes of light to spell out the words or numerals in the telegraph code used. By means of the telescope the operator is able to see the distant flashes of the answering searchlight, and in this manner two-way communication is maintained as long as desired.

Despite the fact that the new signalling equipment is light in weight, consisting of but the searchlight and battery, and therefore readily portable, it is said to have a range of 10,000 feet in broad daylight and considerably more than that at night.

A Traveling Shoe-Repair Shop for the Army

SHOE machinery on wheels has been added to the equipment of the soldier by the Massachusetts National Guard. This is the first machine equipment for the comfort of the foot soldier in any of the armies of the world, and represents a long step toward solution of the problem of keeping an army well shod.

The outfit, which we illustrate, consists of a large motor truck, with trailer. The machinery is operated from the motor of the truck, while the lights are run by storage battery. Detailed description of the interior arrangements is made superfluous by our excellent photograph. The machines shown have a capacity for resoling 400 pairs of shoes per day, and storage space is provided for all the materials necessary, as well as for 1,500 pairs of shoes. The outfit is thoroughly equipped with duplicate parts to prevent delay from breakdown—alike of the shoe machinery, of the truck and its engine, and of the electrical installation.

It is realized that the greatest need for repairing the shoes of an army comes after the unit to which the shop is attached has completed a march. In order that it may be immediately available at that time, sleeping accommodations have been provided in the trailer, so that the men who operate the machines may sleep while the army is marching, and be ready to put the foot-gear in order during the night, while the army is sleeping.

The Current Supplement

PROBLEMS of our universe are always of interest, but many of the important discussions are so scattered that few are able to follow them. The article on *The Origin of the Solar System*, in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2178, for September 29th, is particularly valuable as it gives an outline of the three principal hypotheses pertaining to the discussion. *The Great Canadian Telescope* describes and illustrates a magnificent 72-inch reflecting telescope that has been under construction for some time, and but recently completed and installed near Victoria, B. C. A technical paper that will be of value to many scientific readers is *The Refractometry and Identification of Glass Specimens. Fighting Forest Fires* describes some of the methods of our Government for protecting our timber resources. There are a large number of particularly fine photographic illustrations. The article on *Osmotic Pressure in Animals and Plants* is concluded in this issue. *Shells of the Fighting Nations* describes various designs now in use. *A Problem of the Universe* discusses the question whether our earth is the only life-supporting body among those which traverse space.

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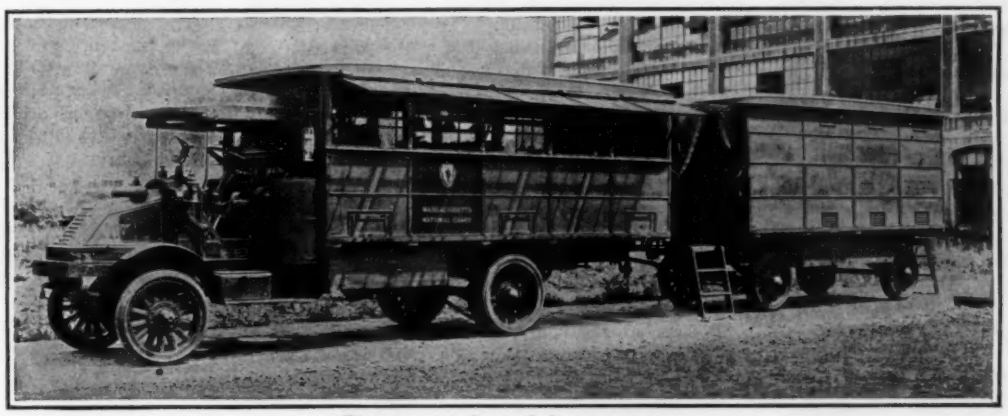
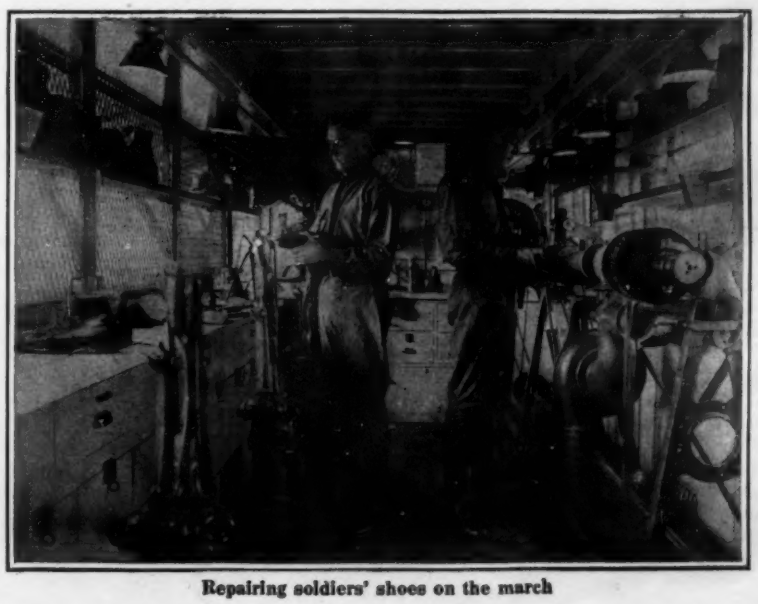
Searchlight equipped with telescope used for signaling to aircraft



The shoe-repair truck for army use



Repairing soldiers' shoes on the march

A Potash Mine in Abyssinia

IN 1911 an Italian resident of the Colonia Eritrea discovered near the boundary line between that colony and Abyssinia an extensive deposit of potash salts. This boundary line has never been definitely fixed and the potash deposit, which was at first considered to be in Eritrea, has for the time been conceded to be in Abyssinian territory. The discoverer of the deposit obtained a 35-year concession from the Abyssinia government.

Its location is in a barren and waterless district about 74 kilometers (46 miles) inland from the little Red Sea settlement of Fatimari. This settlement does not appear on the maps, but may be located as just back of the island of Baka, which is given on the maps. Fatimari is about 76 miles south of the port of Massowah, and less than 400 miles from Aden.

The potash deposit is large and is said to resemble those at Stassfurt, Germany. The operating company estimates there are available at least 850,000 tons of salt deposit, averaging not less than 55 per cent potash. There are hot springs that add steadily to the deposit.

Until 1914 practically nothing was done by the concessionaire to develop the potash mine. Shortly after the outbreak of the present war an Italian company was formed, which company it is said paid the concessionaire 2,500,000 francs ($482,500) for his rights. This company started active work in opening up the deposit and soon had approximately 8,000 men employed in mining the potash, making a road to the coast, and building a port at Fatimari. The potash was taken to the coast by camel loads at a cost of about 250 francs ($48) per ton. At Fatimari some of it was lightered to large steamers, but a great deal was loaded into sailing dhows and other small boats, which could come in to shore, and taken either to Massowah or to Aden for transshipment.

One of the members of the company is the proprietor of a large chemical industry in Italy and he agreed to take 1,000 tons of potash per month, the estimated total output of the mine, at a price of 1,000 francs ($193) per ton.

Owing to the value of the potash for munitions the company contracted about six months ago with a firm at Massowah to build a light railway from the coast to the mine. The firm constructing the railway was to receive the same freight rate per ton as it cost to transport the potash by camels, namely, 250 francs. It was estimated that about 7,000 tons per month could be brought by the railway to the coast. The construction of this railway began with the current year, and the grading has been completed. It is to be a 60-centimeter gage. The rails and ties were purchased from the management of the Compagnie Franco-Ethiopien de Chemin de Fer at Djibouti, and the engines and cars were ordered in America. The track has not yet been laid, and work on both the railway and the mine is temporarily suspended pending the adjustment of difficulties connected with the management of the company working the mine.

Completing Military Camouflage with Camouflage Robes

CAMOUFLAGE, in order to be effective, must be complete, just the same as a half-hidden object is not hidden at all to the careful observer who knows how to direct his search for it. Even though a gun may be camouflaged with consummate skill, its position is soon betrayed to an enemy airman if the crew move about in their usual uniforms. In other words, it is not sufficient to camouflage the gun; the crew, too, must undergo a similar treatment, under penalty of discovery and annihilation.

Recently the French have introduced a bizarre form of camouflage robe which is the subject of this week's cover design. It will be noted that the gunners of the 75-millimeter anti-aircraft are wearing a loose garment over their usual uniform. The garment includes a hood and mask which completely enclose the wearer's head, while a suitable camouflage paint design breaks up the outlines in the desired manner. It is reported that gun crews thus dressed are only discovered by hostile airmen with the greatest difficulty and with considerable risk because of the necessity of swooping low down in order to unmask the camouflage.

Ideas That Will Not Work

The Council of National Defense Must Keep an Open Mind, in Spite of Thousands of These

By C. H. Claudy

FOREIGNERS have derisively called us a nation of shop keepers. If we don't mend our methods we are very apt to be dubbed a nation of phrase makers. For we can read daily in the papers that this is a food war, that money will win this war, that the great conflict will be decided in the air, or under sea, or in the munitions factory, or in the domestic kitchen, that it is a politicians' war, a rulers' war, a peoples' war, a war for right and justice, or a war for profit and economic expansion. In fact it seems to be almost every conceivable kind of war. So of course it is a "scientists' war" and of course "the war will be won by American inventive genius!"

Let us hope so. But don't let us think so without something more to go upon than hope.

The Council of National Defense, doing a thousand things at once, and all of them with a speed and accuracy which has done more to cut red tape and eliminate lost motion from the ponderous peace machinery of Washington than the most intelligent of government officials thought possible, has time to spend on the scientist and the inventor. That is, when John Smith invents a 92-mile range air-gun which shoots 10 tons of dynamite at an aeroplane which can't be seen, and sends the plans and specifications of the "invention" to the Council, the letter and the plans are not waste-basketed or pigeon-holed. If the invention is military it is passed over to the National Research Council for investigation, or to the proper officer in the War Department detailed to handle just such matters. If it is Naval, it will be handed on to the Naval Consulting Board, or perhaps to the Ship Protection Committee of the Emergency Fleet Corporation, for investigation and action.

No inventor or scientist with what he believes to be a solution to any of war's problems goes unheard. It is discouraging work, trying work, work without much reward, because 99.999 per cent of suggested ideas are either (1) old and already adopted, (2) old and discarded, (3) mechanically or scientifically impossible, (4) possible but inexpedient, or (5) defeating one aim in achieving another.

As examples of the five classes there might be taken (1) a telescopic sight for a rifle (2) telephoning along a beam of light, (3) electrifying the ocean to "electrocute" submarines, (4) building half a dozen hulls to a vessel, with a 10-foot space between each to minimize submarine destruction and (5) surrounding a merchant vessel carrying grain with a dozen empty ships which may be torpedoed at the enemy's pleasure—a suggestion which would undoubtedly save the grain carrier but hardly increase the tonnage carrying capacity of the fleet to any alarming extent!

Thousands of Plans, Most of Them Bearing on the Submarine Problem

There are literally thousands of plans, suggestions, inventions, drawings, models, devices, ideas, pouring into the government all the time, all bearing on the war, and most of them on the submarine problem. They indicate, as the Naval Consulting Board has publicly recognized "the patriotic fervor of the mass of our citizens." In trying, very gently, to stem the flood of impractical ideas there is no feeling in the Council of National Defense or in any board, commission or committee handling inventions or suggestions, that these are laughing matters or that the most impractical suggestion should not receive a respectful hearing. But because this is war time, and time and effort are precious, it is thought that if some of these patriotic offers were first submitted to some scientists or technician before being sent to the government, much time and effort might be saved.

For instance, thousands and thousands of letters have been received suggesting, commanding, imploring the use of electromagnets on ship board to "attract the enemy torpedo out of the path of destruction." According to the man or woman who has seen a small electromagnet lift a heavy bunch of steel rails in an industrial plant, naval officers must be blind to the possibilities of their profession, in not, long ago, equipping all merchant vessels with a magnet, which would carry from its course the onrushing torpedo! Yet, as was made clear in the SCIENTIFIC AMERICAN for July 7th, this is a sheer absurdity, of no more practical value than to suggest blowing feathers in the air to deflect a bullet. Were there the slightest chance that a magnetic disturbance could interfere with a torpedo, not only would the Navy work on it and perfect it, but the great electrical industries which have put their enormous and superbly equipped laboratories and their highly trained technical staffs at the disposal of the government, would long ago have worked out the problem.

Wherein Suggestion Differs from Invention

Electricty and its application is a very complicated branch of science, both pure and applied. So familiar are we with some of its wonders—telephone, electric light, wireless, street car, power transmission—that we are all too inclined to think its powers have no limits. Hundreds of letters suggest the "electrification of the ocean," dozens more propose "electric bombs," still others suggest "ships which can shoot electric thunderbolts" or "mortars to propel electric charges at the trenches"—all suggestions of the most fascinating character for the writer of fiction, but with absolutely no practical value. The impulse in these suggestions is sometimes financial in origin, more often wholly patriotic, but the purposes of efficient prosecution of the war are much better served if all such vague and tentative ideas are kept from taking time and effort on the part of government scientists, committees and boards. The Naval Consulting Board sums up the situation when it says that "Suggestions along these lines should show that the writer has made research in the laws governing the application of electrical energy and should contain sufficient proof of their feasibility to insure serious consideration."

Mark this well—no statement is made here, or by any government official, that "electric thunderbolts" are impossible or that "charging the ocean with electricity" is a thing which can not be done. What is asserted is that there are no *known* ways of doing these things—suggestions that they be done are valueless. Submission of a practical method of doing these things would meet with the most respectful attention.

The obvious occurs to every one. What, apparently, occurs to no one is that what is obvious to him is obvious to others! Thus, there have been so many suggestions for screens, nets, fences, out-rigger armor and other extensions to a vessel's hull to protect it from torpedoes that they are uncountable. Inventors would build them of wire, of cord, of netting, of wood, of rods, of screens of cloth. Steel plates suspended, iron plates floated on catamaran rafts, lead plates supported on buoys, complicated structures of trussed iron rods, buffers made of everything from stuffed bladders to seaweed in canvas bags, the gamut of possibility and absurdity has been run in "wonderful inventions" which will protect a helpless hull by "catching the torpedo" before it reaches the ship and explodes.

A Torpedo Does Not Have to Hit Nose-on to Explode

It is a curious thing that hardly one such inventor in a thousand has any other conception of a torpedo than as an instrument of explosion which is "set off" by impact with a resisting object. How far the "torpedo" of childhood days—the little paper package of small pebbles and fulminate which only "went off" when thrown violently on the ground—is responsible for this notion it is impossible to say. As a matter of fact, a torpedo doesn't need to hit anything nose-on to explode. If its course is suddenly arrested, it blows up just the same as if it had struck. Catching a torpedo in a net, supposing it could be done, would not save the vessel spreading the net, unless indeed, the net were at a considerable distance from the hull. Stopping the torpedo by a wire or steel rod network would help not at all. Water is so solid and resisting a medium, as far as an explosive blow is concerned, that the explosion of a torpedo anywhere near the vessel will wrack its plates open almost as well as if the explosive were in contact with the plates.

Now it is not contended that it is *impossible* to protect a merchant vessel by suspended screens of some sort. But so far no such suggestions have been thought practical by either Navy Department or Naval Consulting Board. It is not enough to protect a vessel—the protection must not increase the hazard in one direction while reducing it in another. Nets and screens of all sorts require power to drive them through the water, power requires coal, coal requires space, space can only be taken from cargo or troop carrying capacity. To allow the protection to slow up the vessel unduly is to keep her longer in the submarine zone and permit her to be subjected to gun fire at the pleasure of the submarine.

Speed the Best Antidote for Submarinitis

The percentage of vessels having a speed of over fifteen knots an hour which have succumbed to submarines is small. Speed of vessel is the best antidote to submarinitis yet found. Moreover, screens, nets and other outside protection, often in their very nature preclude the launching of life boats or rafts and no one wants to go to sea with the hull he inhabits as his last resort. Protection *may* be done by screens—it has not yet been accomplished, although thousands of disappointed inventors cannot understand why their ideas are not practical.

A good illustration of clever but impractical ideas is found in the proposal of a capable man who worked out and sent in a scheme to protect hulls from submarines by jets of water. Any one who has ever stood near the nozzle of a fire engine hose when it was working, or watched a hydraulic mining outfit eat into a hard clay bank, realizes the tremendous blow which a swiftly moving, broad jet of water can strike. This inventor proposed a series of such jets, which would spurt from the vessel's side, deflecting and pushing away the torpedo and thus saving the vessel. He didn't calculate that the number of jets he proposed and their size, required some ten thousand horse-power for their making.

Ten thousand horse-power is enough for several merchant ships, even supposing a vessel had plenty of time to stop, change her power application from propellers to pumps, and use up coal squirting water at the approaching torpedo. The fact that a torpedo travels ten to fifteen feet below the surface, that it cannot be seen, that the wake of bubbles it leaves may be from fifty to two hundred feet behind it, all militate against any scheme which demands observation of the onrushing destruction for successful application.

Why Mortars Are Not Used on Merchant Ships

It has been proposed, and very logically, that if a torpedo can ruin a ship by exploding near it, then a depth charge of high explosive, exploding anywhere in the vicinity of a submarine, ought to "kill it." So, undoubtedly, it would. But to plant a depth charge means a mortar, which can throw several hundred pounds of explosive up in the air, that it may dive down into the water near the sub—and that means a special, heavy gun, and very special and very heavy deck construction of the vessel mounting it. Of course it can be done, but it cannot be done in time, with a practical regard to expense, or with sufficient probability of being successfully used, to make it worth while to undertake equipping every possible bottom with such elaborate devices.

The suggestions for improving death-dealing apparatus for land fighting, while not so numerous as the submarine inventions, follow the same general trend. That the vast majority are suggestions that such and such a thing be done, with no instructions as to how to do it, a single example will suffice to show. To write to the War Department and say "Mount a tank of oil on an aeroplane and let it dribble down on a trench while ignited—no soldiers could then live in the trench" is not an invention. It is not even worth reading. Soldiers know that the carrying capacity of an aeroplane is increasingly limited as its speed is increased, that slow machines over the enemy's lines are certain to be shot down, that safely to approach a trench near enough to make certain of hitting it once is very, very difficult, and that to approach closely enough to trail burning oil along its length is simply impossible. Some way of squirting burning oil down from a great height and making it land where it was aimed would be sufficiently horrible to satisfy even the worst German exponent of frightfulness, but instructions to make it possible are not forthcoming.

Submarines to be detected by sound means, and sapping parties to be discovered by microphone ear pieces, share equally the favor of the sound-detection "inventions" submitted by the average amateur inventor who would help his government. Now there are ways of detecting the approach of enemy vessels by means of sound, and sapping parties can be discovered before they arrive by microphone detectors. But those who study, perfect and labor with these devices are either physicists of repute who have given their lives to the study of sound and delicate instruments, or soldiers whose practical experience in the field is worth as much as the formula of the scientists. Those who sit at their desks and write to the War Department that a pair of wires and a head piece will infallibly detect submarine or sapper are merely proposing what is already working, without even knowing that the art has gone far beyond their elementary conception of its possibilities.

Nothing here written must be construed as discouraging real inventive effort. In spite of the deadening effect of being every day compelled to plow through mountains of correspondence, examining hundreds of drawings, looking at enough pictures to fill a gallery, knowing all the time that most of this material is worthless, the Naval Consulting Board has managed to maintain a sympathetic attitude towards the inventor who has something to offer. No ridicule is heaped upon those whose enthusiasm is greater than their knowledge, and every consideration is shown the fanatic who insists, often most belligerently, that the members of the Board are unpatriotic because they do not accept the idea proposed and thus put a summary stop to hostilities.

(Concluded on page 235)

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Headlight Control

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of September 8th, I have read your article on the painting of the lamp-bulb to prevent the dazzling light from the automobile headlights. I have found that substantially the same result can be obtained, and I think with less loss of light, by painting over a sector of the reflector. This can be readily done with practically no expense by using a mixture of lamp-black and soft-soap which can be readily washed off without injury to the reflector.

The New York State Law in this respect applies only to that portion of the beam of the reflected light projected to the left of the axis of the vehicle when measured 75 feet or more ahead of the lamps, and the only provision as to that portion is that it shall not rise above 42 inches on the level surface on which the vehicle stands. With the assistance of an observer facing the car 100 feet or so away, standing slightly to the right of the axis of the car, one can readily determine by actual demonstration with a piece of black paper just what part of the reflector should be painted over, or he can experiment with the lamp-black in the first instance and paint over additional surface where needed or wash off any surface which has been unnecessarily painted over.

In your article you advise painting the front end of the bulb which would not seem to be necessary under the law, as the law applies only to the *reflected* beam of light. There is no limitation on the light which comes directly from the lamp; and by painting the reflector instead of the bulb, all direct light from the lamp is available. The sector of the reflector which should be painted over is the lower left portion as the observer faces each lamp.

C.

Troy, N. Y.

Motor Lubrication

To the Editor of the SCIENTIFIC AMERICAN:

I quote from your issue of August 4th, page 73, as follows:

> "*The Lubrication Question:* That the last word has not been said on the matter of lubricating systems is evident from the fact that cars and trucks using splash lubrication in their motors, in heavy service, working side by side with others equipped for circulation of oil, will stand up well, giving exactly as satisfactory results. It may be, however, that the human element has something to do in the matter."

Will you permit me to mention at this time that I do not believe that, in most cases, men approach the lubrication problem of a truck motor from the most important phase. As builders of lubricating systems for two-thirds of the total production of gas tractors in America, we have necessarily gone into the lubrication of heavy duty motors of all types very thoroughly.

The main point of difference between the lubrication of such motors is, in my opinion, whether the wearing surfaces are supplied with fresh oil or used crank case oil. In these times when kerosene and lower grades of gasoline are used in a motor, the condensation is so great that crank case oil is polluted to a degree that lessens its lubricating values seriously. In tractors the problem has been solved by the use of the force feed lubricator which furnishes *fresh* oil to each main bearing and cylinders in just the proper quantities.

I believe that the splash system is practically as efficient as a circulating system, inasmuch as the oil is carried in the crank case in either case. In either case all parts of the motor get enough oil, but it is of such a quality that undue wear takes places with a consequential loss in efficiency and power.

THOMAS E. COLEMAN.

Madison, Wis.

Why Tracks Wear Out

To the Editor of the SCIENTIFIC AMERICAN:

Having for several years made something of a study of forces brought to bear upon and against railroad rails, I have read with interest the article in your June 23d number on this subject.

As from an examination of the illustrations and the conclusions formed—based upon the tests made—I consider the article somewhat fallacious, I beg the privilege as a layman of making a reply.

Many times, while watching a passing train roll over rail and noting the depression of the ends of the rail when the wheels struck the joint, I have thought I would like to make a test in a similar manner as the one shown, but for a different purpose. Let me say now in passing that right here may be found one of the many causes of what is often called "broken rails"—due principally to an ill-devised but commonly employed fish-plate.

There are so many forces produced by a moving train on a track, and from so many directions, that cause not only ordinary wear but often spreading and broken rails, that it seems a wonder engineers do not wake up to a study of them and until they do, these evil defects will never be provided against and overcome.

It is not my purpose at this time to discuss the subject further than as concerns the article in question, and as it may perhaps be found my conclusions of the comparative wear of the track by the two classes of trains are much the same as those therein expressed, I will arrive at them in a different manner.

In the test diagrams shown, I note—and as the same is pointed out—that the deflections of the rail are about the same in extremes, in the case of each of the two trains. This shows, does it not, that the lighter weight car was heavy enough to reach the limit of depression to absolute solidity, and that was as far as even the heaviest driver could go? Also, that only one wheel could be on the spring limit at the same time, thus the adjacent ties would act as fulcrums and the wheel following, or in advance, would then be a counter weight to hold the body of the car or engine in a level line.

In the case of the markings of the freight engine, as different from the passenger, I assume the draw-bar pull of the engine, due to the slower speed and the greater weight of the following train, would act as a hold-back and would keep the pilot more in line, and consequently the pony wheels could make but little depression.

It is unnecessary to criticize the test at length. While the complete showing is no doubt true as it occurred—as producing the desired evidence I believe it is a failure. Could such a test be made on a long bridge, under the same conditions, it might be of some value, but that is not practicable, as speed and other desired evidences would be lacking.

As theoretically making a distinction between the two trains, it is my belief, based on other observations, that under all conditions the passenger runs and wears much lighter on the rails than the freight and in proof of this, speed, for one thing is an important contributing factor.

Very soon after the starting of a train, the displaced atmosphere sets up its action upon it, and as the speed increases, relatively, so much more atmosphere must be fought against and carried back toward the vacuum at the rear of the train. The wheels and trucks may hold pretty close to the rails, but the bodies of the cars, limited by the springs and couplings, will oscillate through the air like a boy running with paper ribbons.

Intermittently this same force against the mass will cause the train or part of it to bear upon the rail with more intensity, but in the main the principle weight of a passenger train is carried by the engine, while with the freight, although by its greater length and weight, the engine draws on the rails more constantly—not being relieved by momentum—and by its slower speed, displacing a lesser amount of atmosphere, which is sooner diffused, the whole train is therefore bearing almost constantly on the rails.

Among the visible observations of the comparative action of atmosphere against the two classes of trains, may be cited the displacement of dust underneath the moving train, and the discharging smoke from the engine, or, stand near a passing train and note the disturbance felt on the person.

In case of the accelerated motion of the passenger train, whatever smoke may be seen is always directly following the line of the train, even though the train were running in the direction of the wind. Some manifestation of disturbance is always present, but with the freight the smoke goes in the general direction of the wind and often the engine labors with the smoke dead ahead.

There are many phases of wear, not only on rails, but of the general maintenance of track, that a limited communication is not sufficient to cover and do them justice and furthermore, it is not my purpose to attempt to settle a legal controversy between contestants, but when a great technical publication like the SCIENTIFIC AMERICAN gives valuable space to a mistaken theory it seems well that attention be called to it.

There is never an effect without a cause, and a careful study of conditions found, together with forces producing them, will often suggest remedies that may obviate many evils.

WILLIAM H. HAIGHT.

Northfield, Minn.

Train Wrecks and Car Safety

To the Editor of the SCIENTIFIC AMERICAN:

To those who have followed closely the efforts exerted toward safety in railroad travel, the recent wreck at Mount Union must have been peculiarly shocking in that the persistent, painstaking efforts that had borne such good fruit were frustrated by what must be regarded as the inexcusable recklessness of a locomotive engineman.

If, however, we assume that accidents must occur occasionally and consider the ability of the equipment to withstand collisions and derailment, it seems that much may be learned from this wreck.

I have before me photographs of the wreck under consideration as well as of the following:

Chicago, Milwaukee and Puget Sound R. R., Odessa, Minn., SCIENTIFIC AMERICAN Feb. 3, 1912, p. 105.

Pennsylvania Railroad, Glen Loch, Pa., SCIENTIFIC AMERICAN, Jan. 25, 1913, p. 92.

New York Central and Hudson River R. R., Hyde Park, N. Y., SCIENTIFIC AMERICAN, Jan. 25, 1913, p. 92.

I also have a distinct recollection of the wreck at Tyrone, Pa., on the Pennsylvania Railroad in July, 1913.

The accidents at Glen Loch and Hyde Park were derailments and all the cars actually derailed appear to be standard all-steel Pullmans which, under these circumstances, behaved satisfactorily.

On the other hand, the accidents at Odessa, Mount Union and Tyrone were all rear-end collisions of exceptional violence, the appearance of the wreckage being remarkably similar in the first two cases. In discussing the accident at Odessa, you imputed part, at least, of the disappointing behavior of the damaged cars to the fact that, instead of a continuous box-girder extending from buffer to buffer, these cars had castings at the ends and the structural girder extended only between the trucks; now this construction has characterized every one of several published reproductions of plans of all-steel Pullman cars (the cars in the Odessa wreck were, I believe, built by the Pullman Co.) that I have seen and these plans included those for the first all-steel Pullman cars supplied to the Pennsylvania Railroad. I have, because of my interest in this subject, frequently looked at the underframes of all-steel Pullman cars and, in every case, they appeared to be of this construction. I have, therefore, concluded that this is a standard practice with the Pullman Company.

In each of the three last-mentioned wrecks, the locomotive of the rear train struck a steel Pullman car and, in each case, penetrated only to about the location of the end of the structural girder, the remainder of the energy expending itself in causing telescoping with the second car ahead in the two first-mentioned wrecks and in crumpling the vestibules for some few cars ahead in the wreck at Tyrone. In this last one, all but the rear car were, I believe, Pennsylvania cars embodying the buffer-to-buffer box-girder. Moreover, the crumpling of the vestibules consisted, not in tearing the cars open but rather in pulling the sides and roof in together to form an accumulating mass of increasing resisting ability.

It would appear, then, that, as indicated in your article on the Odessa wreck, the Pennsylvania cars begin offering strong resistance at the buffers, not waiting until the penetration has reached the truck, and that they hold together at the couplings instead of telescoping. The first property is certainly and the second probably due to the buffer-to-buffer box-girder.

My agreement with your opinion as to the relative merits of the two types of construction is thus confirmed, and I should be glad to see the SCIENTIFIC AMERICAN undertake to impress its view in this matter upon those who may, in consequence, be led to improve the wreck-resisting qualities of modern American passenger equipment.

AUBREY D. BEIDELMAN.

Braintree, Mass.

The Congressional Library Roof

To the Editor of the SCIENTIFIC AMERICAN:

With the reference to the corrosion on the roof of the Library of Congress, would remark that it should not have been covered with tinned copper but with plain copper which by the action of the atmosphere would have acquired a layer of copper sulfide and black oxide and lasted a century. It should now be painted with a mixture of precipitated sulfur 1 lb., graphite 2 lbs. per gallon of boiled linseed oil, when it will be good until 2017.

Tinned copper *is* better than tinned iron for vessels, since even when the tin is worn off it pays to re-tin them and by scrubbing the vessels may be kept bright and used for cooking and containing various liquids, whereas tinned iron would give a chemical reaction, blackening and spoiling the contained liquids.

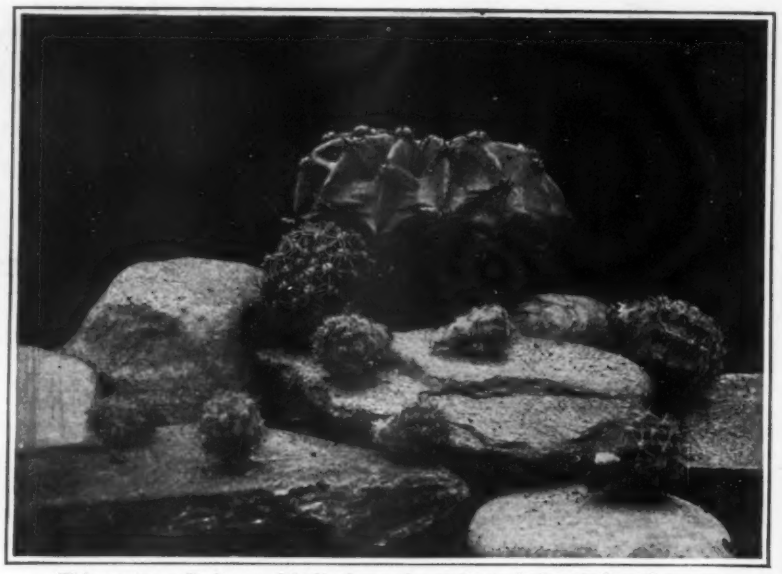
THOMAS LATHAM.

Stamford, Conn.

An Anachronism Corrected

IN our editorial comment of September 8th upon the recently published *Researches* of the Department of Terrestrial Magnetism, we very carelessly repeated the error of our original in putting Halley's expedition of 1698 under the auspices of George III, who came to the throne in 1760. Of course this should have read William III—himself a sailor, and a man who could well appreciate the value of Halley's work on the compass. To those of our readers who were amused by this faux pas it may perhaps be a slight relief to be assured that both we and the editors of the Carnegie Institution really know better.

A Japanese lily which dies while its stems live and take root in a new place



This cactus rolls its seed-balls down the rocks to find a sheltered corner where they can sprout

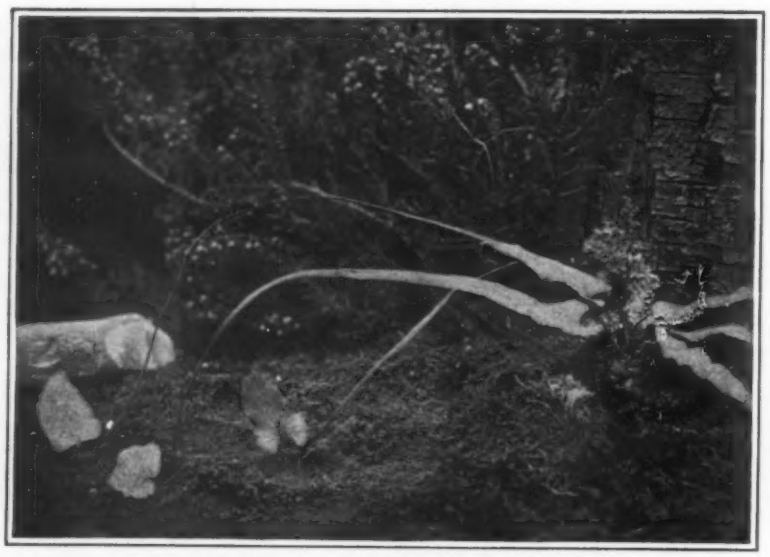
Touring Plants

Curious Devices Which They Employ for Spreading from Place to Place

By S. Leonard Bastin

IN their endeavors to find new positions in which to grow some plants have adopted curious methods. A rather remarkable plan is to be noted in the case of an Alpine saxifrage recently described. The little plant grows in rock crevices and it is only at intervals that suitable positions for the establishment of fresh specimens occur. But the saxifrage has a very novel way of developing thread-like stems of immense length. These shoot out on all sides and continue to extend until they come to a place where there is a little soil. Within a very short time a bud is formed and from this arises a new plant. As soon as this little plant has rooted the connecting stem with the parent dies away. In this way one saxifrage plant will put a baby plant in every rock crevice for a considerable distance around.

Even more singular are the plants that have popularly been called "jumpers." Of these the walking fern (*Scolopendrium rhizophyllum*) of North America is one of the most notable. This fern produces very long tapering fronds which finally become so much extended that the tips rest upon the soil. Almost at once the formation of a tiny bud takes place and from this arises a baby fern. Quite soon an independent plant is well established and it is not an uncommon thing to find scores of young specimens round the parent plant.



The jumping fern is a pocket edition of the banyan tree

Rather different is the plan followed by a Japanese plant, allied to the lilies. In this case, when the plant has flowered, the stems still continue to grow until they become so long that they fall over. Finally they will rest on the soil and at this time young plants are budded off. After a while the base of the stalks rots away and the new plants lead quite an independent existence.

One or two plants in their desire to get about in the world actually break themselves in pieces. A species of cactus belonging to the *Mammillaria* bears a large number of little plants all round itself. When these reach a certain size they become detached and rolling away down the rocks finally settle in some crevice. As soon as the youngsters have found a position they start to send down roots on their own account. The candle plant, *Kleinia articulata*, from South Africa bears round succulent stems. These stems are connected with one another by very thin strands and the whole plant looks as if it had been constricted at intervals by tight ligatures. A very slight pressure on the stems will cause a complete severance at these points. After a rather breezy day the candle plant is strangely broken about; on every side there are odd bits of stem. These roll down rocks and may be helped along by the wind. Whenever they happen to come to a suitable rooting position a new plant soon appears on the scene.

The Alpine saxifrage sends out very long rooting feelers

The joints of the candle plant fall off and develop into new plants

Carburizing Iron by Gas Under Pressure

THE efficiency of cementing or hardening iron by gas under pressure, instead of the modern methods, has been tried by F. C. Langenberg of Harvard University, Cambridge, Mass. He reports in part:

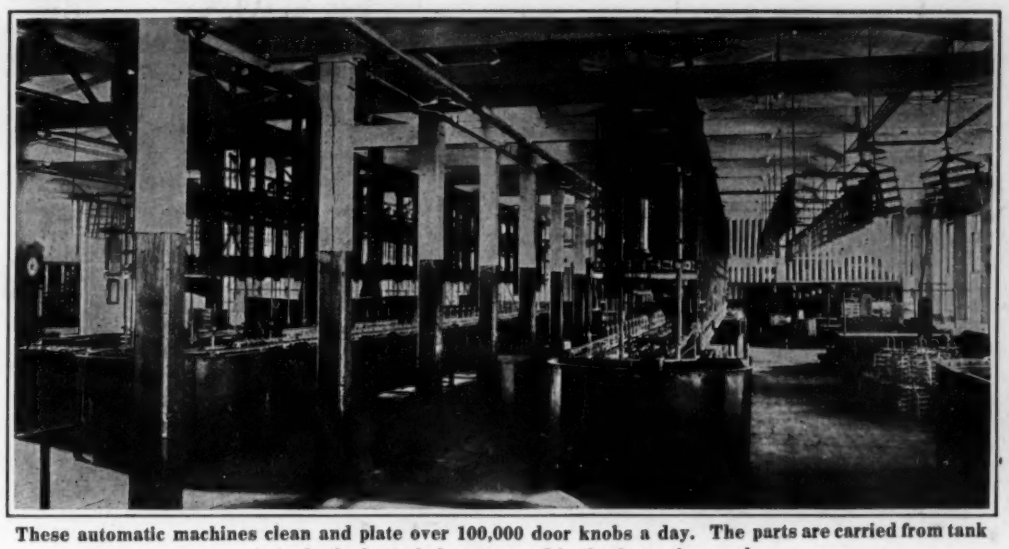
A special form of furnace was used, combining all the requirements of a vacuum and pressure furnace in a single unit. The detailed description of this furnace should be of value to other investigators, for the general arrangements make it applicable to a much wider range of work than the particular investigations of the author.

In the experiments the material subjected to carburization was ingot iron of the following percentage composition: Carbon, 0.01; silicon, 0.002; sulfur, 0.002; phosphorus, 0.003 per cent, with a trace of manganese. The gases used were illuminating gas and acetylene. The samples of iron to be cemented were turned down in a precision lathe to a uniform diameter (within 0.001 in.) and were approximately 0.45 inch in diameter and 0.85 inch in length. Every sample was accurately weighed and measured before and after treatment. Where no oxidation occurred the change in weight was a sufficiently accurate measure of the carburization ensuing. For purposes of comparison this change of weight was divided by the area of the specimen, introducing a column in the data tables, "change of weight per square centimeter of surface."

Twelve series of experiments were carried out, and the author concludes that the gamma-beta points seem to mark a sharp break in the carburization curves for both town gas and acetylene; no carburization ensued below 720 degrees C.; and the effect of pressure on the degree of carburization with the gaseous systems found in illuminating gas was different at different temperatures, indicating that beyond certain pressure further increase will not cause additional absorption of carbon by the iron.

A Machine That Does Away With the Electroplater and Finisher

NOW it is the electroplater and finisher who is threatened with the loss of his work, for there has been perfected a machine that can clean and plate 100,000 door knobs a day, or 100,000 typewriter parts, or even 140,000 parts of miscellaneous hardware, the capacity being merely a matter of making the machine larger or smaller. All the movements heretofore performed manually in the still plating process are accomplished automatically or mechanically in this new continuous plating and cleaning machine.



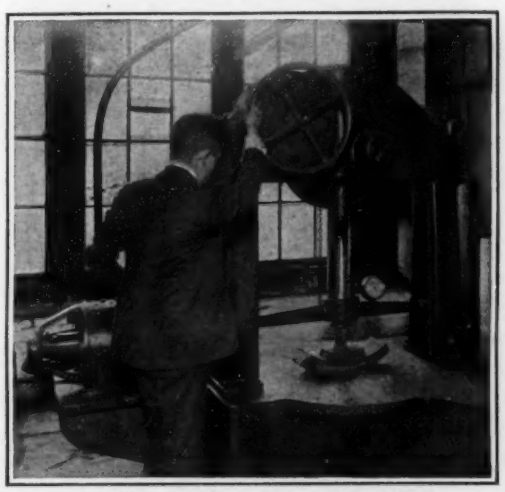
These automatic machines clean and plate over 100,000 door knobs a day. The parts are carried from tank to tank, the latter being arranged in the form of an oval

The new machine consists of a series of tanks of any desired size and shape to conform with the requirements of the work to be handled. The simplest form consists of a collection of tanks required for a single plating process, such as alkali copper, for which the sequence of dips is usually potash or electric cleaner, rinse, cyanide, rinse, plate, cold rinse and hot rinse; but the flexibility of the machine is such that it can be laid out quite as readily for more complicated plating operations involving, for instance, a copper strike preliminary to a nickel deposit or a far more elaborate series of cleaning processes preliminary to any form of plate. The tanks containing the various cleaning, rinsing, dipping and plating solutions are arranged in the form of an oval about fifty feet long. Two endless chains driven by an electric motor and carrying a series of vertical rods from which the work is hung on racks, constitute the carrier system of the machine. By a simple cam mechanism each rod is moved forward and raised or lowered at predetermined points, in order to pass the work through the different baths and to raise it over the dividing walls. The finished work is delivered at the starting point on the right of the machine, in the usual installation.

Because of the continuous movement of the work through the solutions, the quality of the plating is more uniform. Particularly in the plating operation proper is this feature of importance, for the providing of agitation in the plating bath permits current densities in excess of those possible in still tank plating to be employed without danger of burning. The speed of the machine, which is considerable as can be judged from the representative figures already given, is fixed by the foreman of the plating room to give the best results, thus definitely determining the time of immersion in the various baths. For ordinary plating operations the speed is two feet per minute, which means that the work passes through the circuit of tanks in approximately one hour. If light deposits are desired the speed is increased and the time reduced, while for heavier deposits the opposite procedure is followed.

Wheel Sections That Resist Fifty Tons Pressure

THE resistance of hollow wheels of metal to pressures far above what they would meet under conditions of actual use was forcibly demonstrated by a manufacturer of motor truck wheels. Fifty tons pressure was exerted against a half of a metal wheel, which had been cut in two in order to get it under the ram. This, of course, had the effect of decreasing its resistance, yet as the pressure was increased steadily to 100,000 pounds the deflection was hardly perceptible. Micrometer tests showed that at five tons pressure the deflection was 0.002 inch and increased gradually until at 50 tons the deflection of the arch between the spokes measured. 0.033. A number of tests showed that the results were always practically the same.



Applying pressure of 43 tons to a hollow metallic wheel section

Then a spoke section cut from a front wheel was put under the ram and pressure brought up to 25 tons, when the tire refused to hold up under the strain. A steel plate was substituted, following the curve of the felloe, and the pressure was then brought to 43 tons on this small section of the hollow wheel.

A test was made for side strain by applying 50 tons pressure to the center of the unsupported hub of a rear wheel of the size which takes a 40 x 6-inch dual tire. The micrometer showed a deflection of 1/32 inch, and when the weight was lifted, the hub came back to place by reason of its elasticity.

The reason for the endurance of this wheel is the toughness and elasticity of the metal of which it is cast and the use of internal braces that connect and fortify the inner walls. The thickness of the metal is only 5/32 inch and it is possible to produce a one-piece hollow metal wheel that is lighter than a wooden wheel of the same size. Yet it is tremendously stronger than the latter, as the tests indicate, and has the further advantage of remaining round and true under all climatic conditions and severe usage. Owing to the fact that the metal conducts heat readily, while wood will not, the tires are kept cooler, the heat from friction with the road being radiated by the hollow metal structure. This of course adds to the life of the tire.

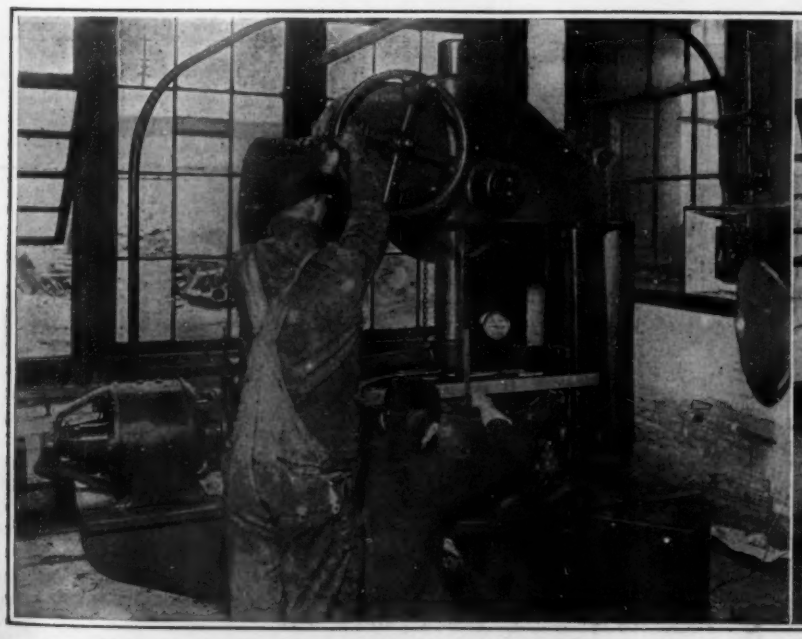
A Reinforced River

FLOATING on the crest of an artificial flood, a fleet of Ohio river barges recently carried down to Cincinnati something like 12,000 tons of coal. The Ohio river never before under similar conditions has seen such an event in August and it is only because man stepped in to aid nature, that the thing occurred. As always is the case in August the river was in extremely low water. Boats drawing more than a couple of feet normally are tied up. But the United States Army Engineering Corps, wishing to demonstrate the supreme value of the river as an artery of traffic in war time, has stepped in with an illuminating illustration of what can be done even in these weeks of scant flow.

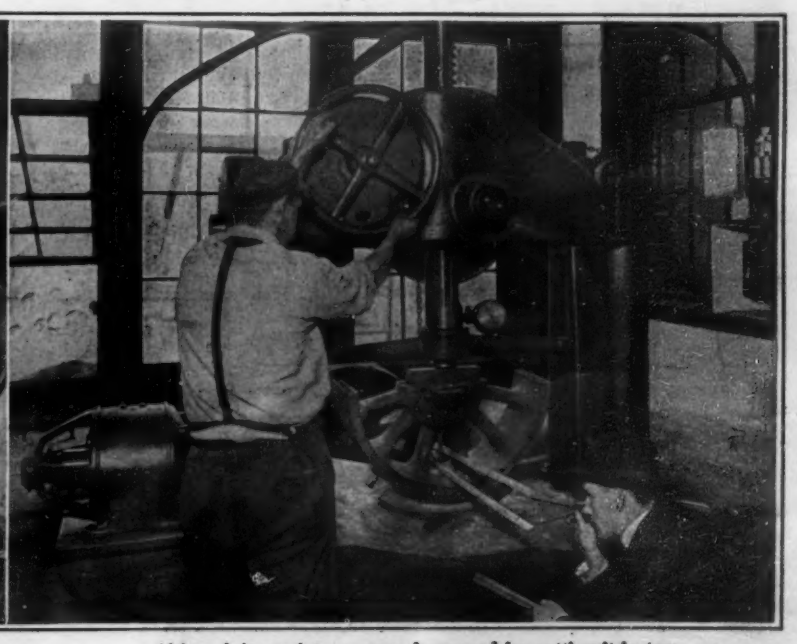
Dams holding back pools along the Big Sandy, the Kanawha and the Upper Ohio rivers were opened recently and surplus water was allowed to run out. An artificial crest of from 3 to 6 feet was formed and on this crest snub-nosed argosies went down the river bearing the coal to the Queen City. Without the presence of the dams which the Government has already completed, this movement and others which will undoubtedly follow, could not be made.

Agricultural Gasoline Permits in France

IN France the shortage of gasoline for some time past has given rise to a number of problems concerning supply and consumption. In industrial and agricultural work the question is of the utmost importance, and therefore the government is engaged in working out a solution which will satisfy the prevailing conditions as much as can reasonably be expected. We note the recent official decree to the effect that gasoline permits will be issued to farmers possessing tractors or gasoline motors, at least in certain specified cases where utility is recognized. Such permits are in two classes, first those relating to agricultural tractors and motor threshers and second, for motors for other uses than farm tractors and threshers. Statistics concerning the total amounts of gasoline represented by the delivered permits will be centralized at the Department of Agriculture.



To demonstrate resistance against dishing, 50 tons pressure was applied to the stripped hub



Although its resistance was decreased by cutting it in two, the wheel supported 50 tons pressure

The Heavens in October, 1917

What the Astronomers Talk About When They Get Together

By Prof. Henry Norris Russell, Ph.D.

THE American Astronomical Society held its annual meeting at the Dudley Observatory at Albany a few weeks ago, and some account of what happened there may appropriately be given here.

When a meeting lasts for three full days, it may seem surprising to say that it seemed too short. But the astronomers of the country are not merely professional associates; they are practically without exception personal friends, and what time was not occupied with talking science was all too short to keep up one's many personal connections. In any case, with nearly fifty papers on the program, there was little reason to complain of lack of material!

Many of these papers were of course, too technical to be of interest to the readers of a column like this. A discussion of the exact effects of refraction upon the determination of the declinations of the stars, or of the possibility of the existence of errors of a hundredth of a second of arc or so in the determination of stellar parallaxes, or of a new instrument for measuring photographs, would hardly be welcome here—though all these subjects evoked lively comments from the men whose own work lay along similar lines. But there were other papers, a goodly number, which were of far more general interest.

For example, Professor Pickering presented the results of measures made at Harvard upon the light of certain asteroids which vary regularly in brightness. In particular, the small planet Eunomia—one of the brighter and longer known members of the group—showed a very regular variation of about thirty per cent in brightness within a period of only a few hours. In the case of a body like an asteroid or satellite, which shines by reflected light, the only explanation of such a variation in brightness appears to be rotation of the body in question. But here several questions arise. Does the small planet rotate in the same direction as it revolves in its orbit (like the Earth) or in the opposite direction (like Uranus)? Again, if the interval between successive minima of brightness is (say) three hours, what is the period of rotation? The matter is not so simple as it looks. If the body is light-colored on one side and dark on the other, and looks faintest when the dark side is turned towards us, there will be but one minimum in every revolution, and the period in the assumed case will be three hours. But it may be, on the other hand, that the variation in brightness is due to the fact that the planet is not spherical in shape. This could not happen for a larger body like the Earth, which has a powerful force of gravity, but might well be the case for small bodies like the asteroids. Now if the asteroid is shaped something like a brick, and is revolving so as to present itself alternately side on and end on, there will be two maxima and two minima of brightness in every revolution, which would lead to a period of six hours in our supposed case.

Considering that the planet is so tiny that no existing telescope could show it as anything but a speck of light, it might seem hopeless to attempt to settle these questions. But in the case of Eunomia the problem has actually been solved. We see the asteroid not from a fixed point, but from the moving earth, and, as thus seen, it seems sometimes to advance in longitude, and sometimes to retrace its steps for a while, and move "retrograde." Now, if the planet is apparently moving in the sky in the same "sense" as that of its rotation, it is easy to see that it will take a little longer for a given part of its surface (say the middle of the dark side), to be turned so that it faces the earth squarely again than would be the case if the earth was not altering its direction from the planet. (Students will recognise here the familiar difference between the sidereal and synodic periods.) On the other hand, when the direction of motion of the planet in the sky is opposite to the sense of the planet's rotation, the reverse will be the case, and the apparent period will be shorter than the true one.

The observations of Mr. Campbell at Harvard are of such beautiful precision that they show quite definitely that the interval between successive minima is longer than the average when the planet is moving "direct" in the heavens, and shorter when it is retrograding. It follows beyond dispute that the planet rotates in the same direction as the Earth and the other inner planets.

What is more, an easy calculation shows that the magnitude of this effect will be twice as great if the period of rotation is double that of the light variation as it will be if the two periods are equal, and the calculations show that in the present case the period of rotation is the same as that of the variation in brightness, so that it is probable that the latter arises from the existence of light and dark patches on the asteriod's surface, and not from irregularities in its shape.

But this was by no means the only thing of general interest. Trümpler of the Dudley Observatory showed that a number of the faint stars near the Pleiades are moving across the sky at exactly the same rate and in the same direction as the brighter members of the cluster, and hence are undoubtedly really outlying components of the group, which is thus shown to be about six degrees in diameter—some three times as big as had previously been supposed.

Father Rodis—a Jesuit astronomer from the Observatorio del Ebro in Spain—showed the results of a beautiful and very accurate method of recording the time of arrival of wireless signals by means of a delicate electrometer—which is capable also of making a permanent photographic record of any wireless message.

At 11 o'clock: Oct. 7.
At 10½ o'clock: Oct. 14.
At 10 o'clock: Oct. 22.
At 9½ o'clock: October 30.
At 9 o'clock: Nov. 7.
At 8½ o'clock: Nov. 16.
At 8 o'clock: Nov. 23.

NIGHT SKY: OCTOBER AND NOVEMBER

The Sun's Magnetic Field

A very interesting discussion of the general magnetic field of the Sun was given by Seares and Van Maanen of Mount Wilson. That the Sun possessed a general magnetic field like that of the Earth, with its "north magnetic" pole near the north pole of rotation, was proved by Hale three years ago. Further measurements upon the minute displacements of the lines in the spectrum, made with almost incredible delicacy, have shown that the Sun's magnetic pole is not quite coincident with the pole of rotation, but is 6.2 degrees from it, and that it is carried around by the Sun's rotation, with a period (as seen from the moving earth) of 31.8 days. The results of this discovery may be of great importance in increasing our knowledge of the nature of solar processes in general.

Last, but not least, may be mentioned a communication from the new Director of the Lowell Observatory. Dr. Slipher, giving the observed radial velocities of ten globular clusters. It appears that these enormous aggregations of stars—which, like the special nebulae, appear to be far more remote than the stars of our own galactic system—resemble the spiral nebulae also as regards their rate of motion. The average velocity is 150 kilometers per second—ten times the average velocity of the nearer stars, though less than half that of the spiral nebulae. The great cluster in Hercules is approaching at the rate of 300 kilometers per second.

These are but a few of the most remarkable of a long series of papers; but enough has been said to show that American astronomers are keeping up the worthy traditions of their calling.

The Heavens

As our map shows, the great square of Pegasus is now high in the south—its eastern edge being almost on the meridian. Carrying the line of this edge southward and bending a little to the left, we strike the bright and very much isolated star 6 Ceti, while the western edge, carried down in a similar fashion, points to Fomalhaut, the only other conspicuous star in the southern sky. Aquarius and Capricornus occupy a large and dull region on the southwest, and Cetus and Eridanus a corresponding one in the southeast.

From the northeast corner of the Great Square runs the familiar line of bright stars, through Andromeda to Perseus. Below the latter is Auriga, and on the right are Aries, Taurus lower down, and Orion rising below him. Cassiopeia and Cepheus are high in the north above the Pole. Ursa Minor and Draco are lower down and a little to the left, and the Great Bear swings low on the northern horizon. Cygnus, Lyra and Aquila form a fine group in the west, and complete the list of the conspicuous constellations.

The Planets

Mercury is a morning star all this month, and should be well visible about the time of his greatest elongation on the 4th. Though hardly 18° from the Sun, he is 8° north of him, and should therefore be easy to see, rising at 4.40 A. M. He is on the borders of Leo and Virgo, and can hardly be mistaken for anything else, as he is brighter than any fixed star except Sirius and Canopus.

Venus is an evening star in Scorpio, setting at 7.15 P. M. all through the month. She is about as far south at the close of the month as she ever gets, and so is less conspicuous than usual.

Mars is a morning star in Cancer and Leo, rising at 1 A. M. in the middle of the month. On the 29th he passes within 1½ degrees of the bright star Regulus, which he nearly equals in brightness.

Jupiter is in Taurus, approaching opposition, and rises at about 8.45 P. M. on the 1st and 6.40 on the 31st. He is by far the brightest object in the later evening sky.

Saturn is in Cancer, and rises a little after midnight in the middle of the month. On the 1st he is in conjunction with Mars, the two planets being less than one degree apart.

Uranus is in Capricornus, and comes to the meridian about 8 P. M. in the middle of the month. Neptune is in Cancer, and is visible in the morning sky being in quadrature west of the Sun on the 30th.

The Moon is in her last quarter at 5 P. M. on October 7th; new at 10 P. M. on the 15th, in her first quarter at 10 A. M. on the 23d, and full at 1 A. M. on the 30th. She is nearest the earth on the 27th, and farthest away on the 11th. As she passes around the sky, she comes into conjunction with Jupiter on the 5th, Neptune on the 9th, Saturn and Mars on the 10th, Mercury on the 15th, Venus on the 19th and Uranus on the 25th. The conjunction with Venus is quite close, and, as it occurs at about 3 P. M., it will be interesting to watch, as both bodies can easily be seen by the naked eye in broad daylight.

Lake Minnewaska, N. Y.

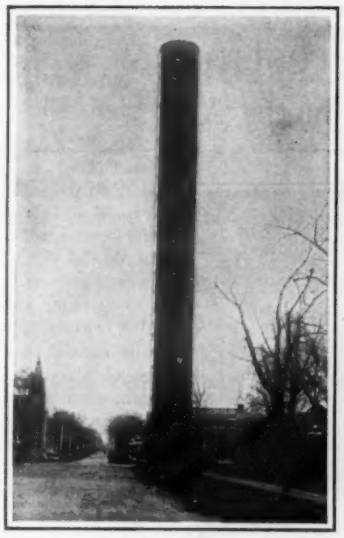
September 18th, 1917.

Photography as an Aid to Builders

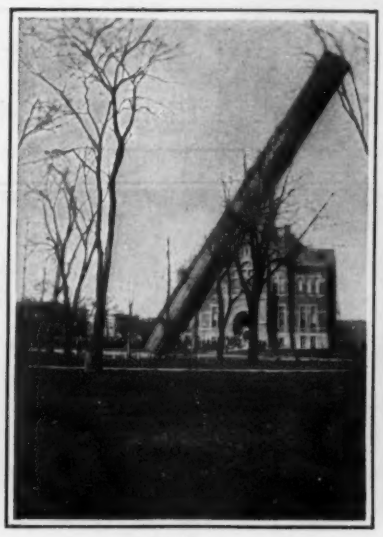
THE camera has become useful to building contractors by its ability to prove the condition of works at a certain date. When necessary photographs can be offered in evidence in a court of law, and progressive firms are insisting on the insertion in their contracts of a clause giving them the right to use a camera. An English sub-contractor for the woodwork in a large building recently forfeited a sum of 400 pounds for a delay for which he was in no way responsible, simply because he was not in a position to prove that on a specified date the building had not progressed sufficiently far to enable him to commence his operations. The camera would have proved his case and saved his forfeit.

Felling a Huge Stand-pipe

THERE is an old saying to the effect that a very small force applied in the right place can move mountains. The truth of this is well illustrated by the methods employed in an Iowa town to remove a huge stand-pipe that had long been a public nuisance. The tube was a relic of the early nineties, when containers of this sort were commonly employed as reservoirs for small-town water systems. Objections to it were that in winter ice formed in the top, to be frequently forced out and upon the streets by the pressure of the water beneath, and that in summer the open end of the tube was hardly sanitary. Besides, in time of fire the old pipe was not particularly efficient, for when the water descended half-way inside, there was not much pressure left to maintain a satisfactory flow. So it was decided that the old landmark would have to give way to a modern watertank mounted on a high tower.



Going—



Going—

Gone!

To get the old institution out of the way afforded the local citizenry a considerable head-scratching problem. Two courses were open—the pipe could be dismantled in sections, or tipped over bodily. The contractor decided upon the latter and more awe inspiring method. A wire cable was looped around the topmost section of the pipe and carried to an ordinary hand winch made fast to a telegraph pole several hundred feet from the base of the pipe. The cable was passed around the drum and the cranks given three or four turns. To the wonder of the assembled crowd, the huge tube, weighing over eighty tons, promptly tilted over to a dangerous angle. A few more turns and over it crashed, striking the ground with tremendous concussion.

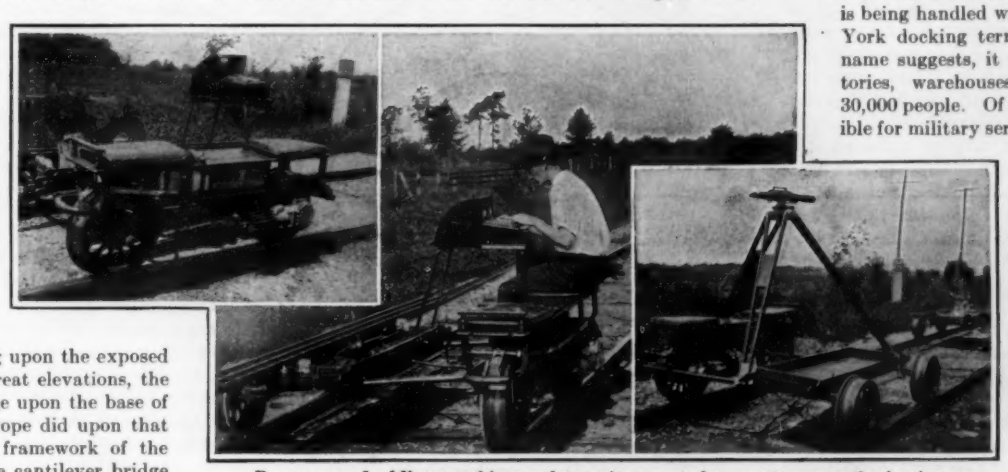
The case illustrates the great wind stresses to which high buildings are subject. When such a tall object once starts tipping, nothing but a special dispensation of Providence can stop it. Acting upon the exposed broadside of the structure at great elevations, the winds get a tremendous leverage upon the base of the building, just as the wire rope did upon that of the stand-pipe. The steel framework of the skyscraper has to be built like a cantilever bridge on end, with special thought to its powers of resisting this leverage.

Modern Equipment for Precise Leveling

BY the use of modern appliances that save time and labor, the field parties of the U. S. Coast and Geodetic Survey engaged in precise leveling have made remarkable records of late. Cars for use on railroad tracks are utilized to carry the instruments, tools and members of the party, and these vehicles, propelled by small gas engines, are capable of a speed of 20 miles an hour, so that great distances can be covered in little time and without fatigue. These cars have a weight of only 350 pounds, and are easily lifted from the track on the approach of trains.

Two cars are employed by each party, one of which carries the level, the tripod being secured to the framework in such a way that the instrument can be transported without injury for a day at a time. As most of the precise leveling is done along the railroad, it is not necessary to remove the level from the car, the observer standing between the rails and sighting forward and backward. Two rods and two rodmen are employed, as all leveling is done in duplicate to eliminate error. Each section, therefore, is leveled in a forward and backward direction. The maximum sight is 490 feet.

The use of a listing adding machine expedites the recording of the rod readings and with a great saving of labor secures accurate results. This device which is in such common use in accounting has been adopted as part of the field outfit, and is attached to the frame of the second car. Instead of the slow process of jotting down the figures in a note book as in the past, they are transcribed on the machine. It has nine columns and adds to ten places, and the method is to list the back sights on the four columns to the left and the foresights on the four columns to the right. By adding the numbers at the end of a section between bench marks, the sum of the foresights and of the backsights is obtained, and subtraction of the two sets gives the difference in elevation between the two bench marks. If the rod is read from three wires, the result must be divided by three.



By means of adding machine and transit mounted on motor cars, the business of precise leveling is greatly speeded up

In a paper read before the American Association for the Advancement of Science last December, by the Chief of the Division of Geodesy of the U. S. Coast and Geodetic Survey, Mr. William Bowie, the foregoing facts were set forth, and the statement was made that with such improved methods the complicated work of precise leveling could be accomplished as rapidly as the crudest kind of spirit leveling. For example, the record made by the party of John H. Peters in Michigan, was mentioned. Precise leveling of 159.6 miles in the month of September, 1916, or 340 miles of single running, was the maximum for that year. The average progress made by a party is 100 miles a month, but as each mile is leveled twice and there is about ten per cent of re-running, the average actual running per month is 220 miles.

This is done at a cost of $10 per completed mile or somewhat less than half that amount for a single mile of leveling, and in this sum is included salaries, traveling expenses, the cost of bench marks and all expenses of setting the same in place, one in every two or three miles.

About 2,500 miles of precise leveling was done by the Coast and Geodetic Survey during 1916, bringing the extent of the precise level net of the United States to 35,300 miles. The plans for the future call for further observations that will result in having no spot more than 100 miles from a precise level bench mark, with steady extension over the intervening spaces. Since 1898 practically all the work of the Survey has conformed to a high standard; allowing not more than $\pm$ 1 mm. probable accidental error per kilometer, and probable systematic error not more than $\pm$ 0.2 mm. per kilometer.

Instructing Women In War Work

THE problem of fitting American women to do the work of some of the men who are called to the colors is being handled with skill at one of the large New York docking terminals. This is more than the name suggests, it is an industrial city, with factories, warehouses and docks employing about 30,000 people. Of these a large proportion are eligible for military service and many have been called. How to keep this big institution going without a hitch was a puzzling question, for much of the work is highly specialized, and capable men above the military age are hard to find. Yet it is a matter of vital importance to keep in active operation this great shipping and manufacturing organization.

The problem was worked out some time ago and recently the representatives of several corporations that employ thousands of workers witnessed a demonstration of what women can do to keep the wheels of industry turning, while their brothers are carrying arms.

Some of the tasks assigned to women are driving the industrial trucks and tractor cranes of the inter-plant system that operates between ships and warehouses, in the factory buildings and on the railroad loading platforms. It was found that these vehicles were so simple to operate and required so little physical strength that the average girl of good physique could handle them with ease in a short time. Yet these trucks with their strings of trailers handle thousands of tons of such commodities as bales of cotton, hogsheads of tobacco and bags of coffee. The reason women can operate them with success is that electric cranes do all the heavy lifting. A girl who can drive a pleasure car is quite capable of

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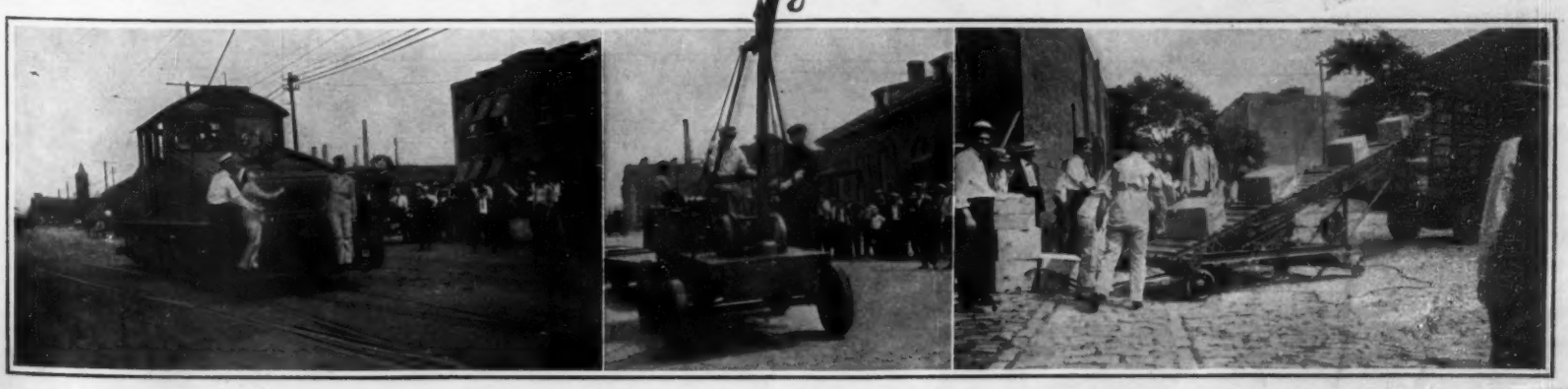


Women workers at Brooklyn's greatest docks learning to drive the electric locomotives, to run the huge tractors, and to operate the conveyor-belt loading machines

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Cracking Nuts by Centrifugal Force

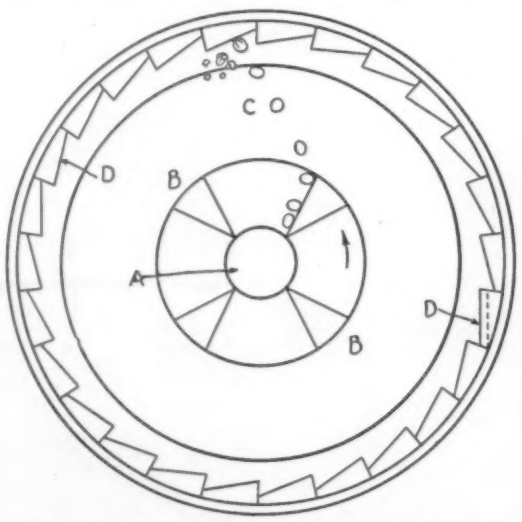
THE United States annually imports palm oil and palm-nut kernels to the value of about $7,000,000. Heretofore, the bulk of these imports have come from the west coast of Africa. From Mexico, however, we have been receiving small quantities, and it has been recently discovered that palm nuts are also to be found in Central America. Recently a company, with headquarters in Los Angeles, prompted by the European war's effect upon the shipments from Africa and the difficulty experienced in developing business in Mexico on account of her internal troubles, invaded Central America and is preparing to develop the industry, principally in Guatemala, on a very extensive scale. This company started with about fifteen tons of machinery, mostly designed especially for the purpose, one of the main units of which is shown in the accompanying illustration. This machine, which was built expressly for the occasion, is a particularly ingenious device, in that it cracks the nuts purely by centrifugal force. Shaped somewhat like a drum and measuring six feet in diameter, it will stand, when the top feed and the bottom discharge have been added, nearly seven feet in height, and will weigh approximately 6,000 pounds, the main casting alone weighing 3,400 pounds.

A nut-cracking machine of elephantine proportions

The nuts will be conveyed in a steady stream to the hopper at the top, and from this hopper they drop into a fast-revolving drum-wheel which hurls them with terrific force against a continuous stationary belt of breaker-blocks lining the inside surface of the main, drum-shaped casting. The nuts have an extremely hard shell, averaging about a half inch in thickness, and to crack them a pressure of about 1,800 pounds is required. The drum-wheel, turning on a perpendicular-set axle, is speeded to 800 revolutions per minute, although it is capable of a maximum speed of 2,000 revolutions, and, hurling the nuts on a tangent a distance of but two feet, the force is just sufficient to break the shell into several pieces, the kernels being thus released. Deflected by the downward-sloping surface of the breaker-blocks, both kernels and hulls drop toward the bottom of the machine, where they enter a discharge pipe and are separated the one from the other by a system of blowers. The machine, which is being patented in several different countries, has a capacity of about ten tons of nuts per hour.

The difficult part of the work of preparing these nuts for the market heretofore has been the matter of cracking the hard inner shell. In Mexico this work is ordinarily done by hand, and is extremely tedious and slow. The machine here described, however, solves the problem very advantageously, and is considered an improvement over other machines designed for the same purpose, both because of its much greater capacity and in that by cracking the nuts by centrifugal force the kernels, for the most part, remain whole and hence do not lose any of their oil.

The outer hull also, in the case of this company which is invading the Guatemalan field, will be removed by machinery designed somewhat on the same principle as the large cracker—which means that practically the only hand work will be the gathering, and this is usually done by raking the nuts into piles after they have fallen from the tree or by cutting the bunches from the trees before they begin to fall. Some of the kernels will be shipped whole and others will be converted into oil on the spot. For obtaining the oil, the kernels are first ground into a fine, oily meal, and this meal is then subjected to a boiling process.



Cracking nuts by hurling them centrifugally against a ring of breaker blocks

The outer covering of the coquito nut also contains a percentage of oil, and this will likewise be utilized where the nuts can be obtained before fully ripening. This hull, when drying naturally, because of its fibrous character, can be used in the manufacture of paper-pulp, and the inner hull makes excellent fuel.

Is This the Solution of the Portable Motion-Picture Projector Problem?

ALMOST from the dawn of motion pictures down to the present day an effort has constantly been made to perfect a projection machine so small, compact and light that it could be taken anywhere and operated by an amateur. One after another so-called "home projectors" have been devised and offered for sale, but each has usually lacked some important requisite when actually put to use, and the problem has been tackled anew.

The latest device which aspires to the title of the perfect portable motion-picture projector which anyone can operate is illustrated in the accompanying views, and under rigid tests it appears to have come nearer the requirements than most of the others thus far. The new projector is light—weighing but 21 pounds; compact—folding up to a size not larger than a small suitcase; uses an ordinary electric light socket as its means of securing current—the light being produced by a specially-made nitrogen bulb which casts a light as brilliant as that secured from the ordinary professional projector; the film can be started or stopped at any point and held stationary on the screen without danger of fire; the film can be turned backward at any time, if so desired, and there are numerous other features which will appeal to those seeking portable projection machines for the showing of industrial or commercial films.

One of the oldest film manufacturing concerns is the originator of the new projector. Having been so long connected with the film industry, it was not difficult for this concern to avoid the mistakes made by previous experimenters with portable projection machines. A case in point is the brilliancy of the light which has been a surprise to many projection experts. A picture equally sharp and clear is thrown on a screen eight feet wide or on a piece of cardboard only eight inches wide, as best suits the requirements of the user. Standard size films are used, and rolls or spools holding a thousand feet can be easily handled side by side. This feature enables the firm already possessing several reels of commercial film to show the subject whenever and wherever it likes. If desired for any reason to lecture with the film as it runs through the machine the new projector can be stopped

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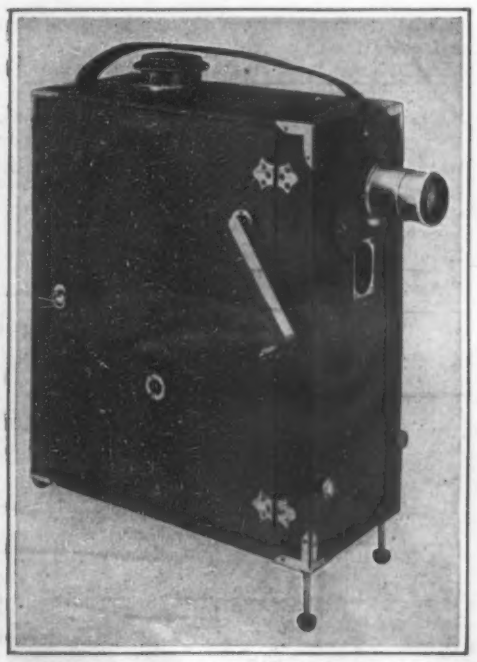
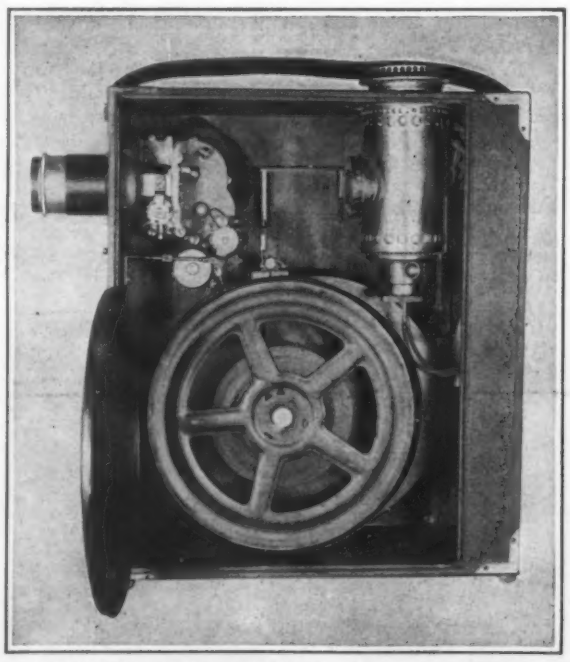
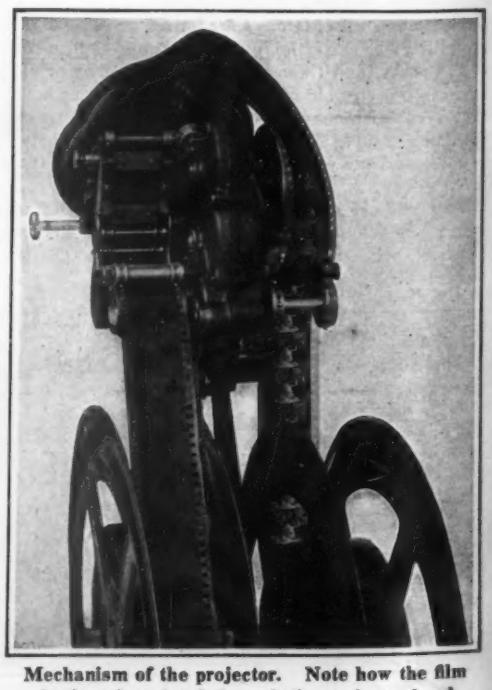


A portable motion-picture projector which weighs 21 pounds complete



Interior view of the projector, showing the arrangement of the film reels side by side



Mechanism of the projector. Note how the film is cleverly twisted through the projector head

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Building the Quebec Bridge

(Concluded from page 221)

feet above the scows, the southwest corner of the suspended span slipped off its supporting girder at the bottom of the hanger chains, and under the abnormal stresses imposed upon the bridge, it immediately commenced to buckle and break up, and the whole structure dropped into the St. Lawrence River.

Two causes were assigned for the failure—one being that the point of attachment of the hanger chain to the lifting girders upon which the span rested, was placed too low down upon the girders, with the result that when the load came upon them they pivoted around their points of support, kicking out from under the truss and dropping the span. The other assigned cause was the fracture and breaking down of the cast-steel rocker joints.

In the present lifting operation, special attention was, of course, paid to the connection between the lifting chains and the lifting girders, and the connection has presumably been made so rigid as to preclude any pivotal movement, such as appears to have brought about the previous disaster.

We hope to give further details of this work in a later issue.

The Submarine Problem XVI.

(Continued from page 225)

Obviously, considerably smaller cylinders may be employed in place of cylinders as large as the larger ones, X. Cylinders X′ but two feet in diameter would serve the purpose very well if charged with water or oil as a heat-absorbing liquid barrier to the explosive blast. That is to say, they would contain enough liquid to absorb sufficient of the energy of the gases to protect the inner structure of the ship, while a large space between the cylinders and the screen would be provided for such heat-absorbing buffer cargo as that already described, which would serve still further to lessen the strain upon the inner structure of the ship.

It will be observed by reference to the longitudinal and vertical views of the screen, that the rods composing it are placed in staggered relation to one another, in such wise as to present triangular faces to the impact of the explosive blast, thereby minimizing the effect of the blast upon the screen, while by this arrangement also the screen is made much stronger.

If the warhead of a torpedo were exploded against the hull of a ship so constructed, the gases formed by the explosion entering the ship, encountering at the start comparatively little resistance, except from the buffer cargo, would not exert so much destructive effect in a lateral direction, and as the gases entered the compartments, increasing the atmospheric pressure therein, they would find vent upward through the apertures or hatchways H, above referred to, and harmlessly escape into the atmosphere.

The space between the two main longitudinal bulkheads or main walls of the vessel is divided into watertight compartments by transverse bulkheads K, these bulkheads being placed at intervals of say about 48 feet. They may be continuous with each alternate outer bulkhead already mentioned, or they may stand in staggered relation to the same. It is proposed to space them about twice the distance of the outer bulkheads, so that if these bulkheads are placed 48 feet apart in a longitudinal direction, the main wall or longitudinal bulkhead A, A, is otherwise strongly supported by the outer transverse bulkheads at intervals of 24 feet. The inner compartments formed by the transverse bulkheads K may be divided by a central longitudinal partition K′. Each of these compartments is closed by a proper hatchway M′.

All of the longitudinal and transverse bulkheads are extended up to the main deck, D, and there should be no passageways between most of them.

The masts and derricks for handling freight should be made hinged or detachable so as to be placed flat upon the deck during the voyage, in order to lessen the visibility of the ship to the enemy.

(Concluded on page 235)

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Pertaining to Apparel

HAT STRUCTURE.—ROSA REISS, 10 W. 46th St., New York, N. Y. The invention has for its object to provide a hat for ladies which is of light weight, and so constructed that it can be given any desired shape. A more specific object is the provision of a hat embodying a form of frame which is so designed that chenille strands or similar material can be so applied to the frame that the hat is as neat inside as on the outside and no lining is required, the chenille strands being woven on the frame by beginning at the center of the crown and laying the strands spirally on the frame much after the manner of weaving baskets.

SHOE FASTENER.—C. M. HARRIS, Kingman, Arizona. The invention has for its object to provide a fastener for securing the flaps of th shoe, without the necessity of a lace, where fastening means will be concealed by the closing of the flaps of the shoe. The invention is shown in

PERSPECTIVE VIEW OF SHOE WITH FLAP CLOSED

connection with a shoe having the usual closing flaps and the fastener comprising a part of curved plates each of which is provided at one edge with openings for receiving a stitching to connect them to the flaps of the shoe, the plates are provided on the concave edge with a series of hooks which are adapted to engage over the edge to secure the flap.

HATBAND.—E. IDOUX, Sea Bright, N. J. An object of the invention is to provide a sweat band of corrugated type and of curved cut, which will render the wearer of the hat more comfortable and which will facilitate the circulation of blood at the points of contact of the head with the band of the hat.

Of General Interest

SMOKER'S STAND.—H C. BOTTY, JR., and C. M. PRIOR, address Henry C. Botty, Jr., 140 Nassau St., New York, N. Y. The general object of the invention is to provide an article of this character, which will do away with dust, odor, danger of fire, or other troubles. A specific object is to provide a stand with a chamberbase adapted to receive the ashes, burnt matches, ends of cigars or cigarettes, from the tray through a hollow column or tubular connection which supports the tray on the base. A draw at the base of the column receives the ashes.

DETERGENT, BLEACHING AND DISINFECTING COMPOSITION.—F. F. CARMONA, care of Joseph E. Christen, Ave. Independencia 25, Mexico, D. F. The invention relates to means for cleansing, bleaching and disinfecting fibrous materials and more particularly to a composition for removing dirt, oils and fat from fabrics and materials from which fabrics are made. The composition is composed of a detergent, a bleach, and a disinfectant which latter, also has bleaching properties, it may be used in liquid or powder form.

ART OF PRODUCING PRINTING MEDIUMS.—I. S. BUNNELL, 16 Nassau Place, East Orange, N. J. An object of the invention is to produce a printing media to be printed from, especially numerals, words and sentences composed of fancy letters and other characters the finished printing media produced being used for reproduction by any of the well known forms of reproduction. Another object is to permit the use of the finished product, in case no extra copies are desired, as a show card, bulletin or similar article.

SCARIFIER.—C. D. FARMER, care of O. H. Foster, Atty., Eugene, Ore. The object of the invention is to provide a device of the character specified for tearing loose clods, stone and the like too near the surface of the road and for removing the torn loose stone and the like from the side of the road.

ERASER HOLDER FOR PENCILS.—J. A. BOOS, 101 Beekman St., New York, N. Y. The invention provides an eraser holder for pencils, and is so arranged that the eraser will be of sufficient length to ordinarily last until the pencil is used up, and to permit of removing a portion of the holder whenever the free outer end of the eraser has become worn down to the holder.

FLUID MEASURING DEVICE.—S. F. MIOTON, 2523 Esplanade, New Orleans, La. The object of the invention is to provide a fluid measuring device which cannot be operated until valve means are actuated, the movement to actuate the valve means releasing a lever which serves to move a member of the measure to draw the fluid therein, the return movement of the lever being prevented, it being impossible to again move the valve means until a determined quantity of fluid is contained in the measure when by means provided, the valve is operated to direct the fluid from the measure and out of the device, and the lever is permitted to return to inoperative position.

VEGETABLE AND MINERAL FIBER FELT.—H. VON UFFEL, care of Prince George Hotel, New York, N. Y. It is the object of the invention to provide a felt made from cocoanut fiber treated with a saline solution and a solution of a calcium compound. A felt thus made has great tensile strength, is non-expansible, non-contractible, non-inflammable, heat-insulating and comparatively light and flexible. It has a wide range of use and may be applied as a roofing felt or as a fireproof insulating material.

DESK CALENDAR.—E. OLDENBUSCH, 366 Butler St., Brooklyn, N. Y. The invention relates to such devices as may be termed perpetual calendars in which there are provided a plurality of independently movable dishes bearing selective legends or indicia. Another object is to provide a calendar made of sheet metal or other substantial material, and assembled without the use of rivets, screws or other fastenings, except tongues made integral with certain of the parts.

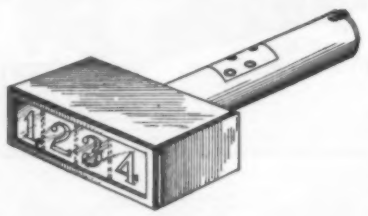
SMOKE FILTER FOR CIGARS AND CIGARETTES.—F. E. FONSECA, 150 Duane St., New York, N. Y. Among the principal objects of the invention are to provide a cigar, cigarette or a similar article with a suitable filter and support for same, to divert the column of smoke from its direct path of travel to retard the rate of travel of the smoke admitted to the smoker's mouth to avoid transmission by infection, and to simplify the construction of the filter employed in the accomplishment of this object.

WINDOW.—M. G. HOUREN, 124 Berlin Ave., Peoria, Ill. The object of this invention is to provide a window especially adapted for street cars and the like for the use of motormen, the window being mounted to rotate and means being provided for rotating it, while cleaning means engages the window at its opposite faces, to thoroughly clean the same from snow, rain, steam and the like, the cleaning mechanism being hidden from view.

TAG SEAL.—L. HARRIS, 787 Crotona Park, No. Bronx, New York, N. Y. The invention has for its object to provide a seal and tag adapted for garments and other articles. The tag is intended to be placed on a garment or article by an authorized person and the tag cannot be detached except by breaking the seal, this is to be done by the customer after a purchase, the merchant can by this means protect himself against imposition by a customer, attempting to exchange or return an article after it has been worn.

RACK.—G. ADAMS, 1286 Madison St., Brooklyn, N. Y. The invention relates to a wire rack particularly suited for holding circular objects, it is formed of two elongated members, identically shaped, arranged to provide space seats to receive circular objects, such as plates, disks, and the like, it is strong, simple and inexpensive to manufacture.

ANNUNCIATOR.—G. ALT, 1106 E. Indiana St., Evansville, Ind. The object of the invention is to provide a hand annunciator, especially adapted for use in moving picture and other darkened theaters for indicating the number



THE PERSPECTIVE VIEW

and location of vacant seats. The invention comprises a substantially rectangular casing, with openings closed by a sheet of glass or the like, the casing permitting the sheet to be withdrawn or replaced, partitions are arranged and divided into compartments, each compartment being illuminated by an electric light.

Hardware and Tools

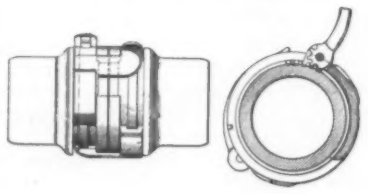
DOOR HOLDER.—C. A. HASS, 81 Broadway, Elmhurst, L. I., N. Y. The object of the invention is to provide a door holder or check to hold the door in any desired position, and to provide a clutch having a gripping jaw which can be readily removed for sharpening purposes or replaced by a new one without requiring the removal of the door holder from the door, to accomplish this use is made of a pivoted clutch plate with removable gripping jaws adapted to engage the bolt.

KITCHEN UTENSIL.—G. E. HENRY, 6211 Girard Ave., Philadelphia, Pa. The invention has for its object to provide a combination utensil especially adapted to kitchen use, in which a variety of tools are combined in a single article the utensil comprises an ice pick, a corkscrew, a cap remover, a strainer, an apple corer, an egg separator, a potato slicer, a potato masher, a vegetable slicer, and a dough cutter.

WASTE RECEPTACLE.—C. C. BROWN, 501 Grand Bldg., Macon, Ga. This receptacle is for receiving ashes, refuse, garbage, or waste material. The object is to provide a receptacle which will automatically close after use, thus retaining dust, and preventing the escape of noxious odors, it can be placed out of doors to be emptied by the scavengers without danger of the contents becoming wet in case of rain.

TOOL.—R. D. CORKE, 125 Lewis St., Yonkers, N. Y. The object of this invention is to provide a machine tool having a series of cutting bits for disposition alternately in service; to provide a tool having a resilient body and replaceable rigid cutters therefor, to amplify the usefulness of a tool of the character indicated, and to simplify and cheapen its construction.

COUPLING FOR HOSE AND PIPES.—W. K. KENNARD, address S. S. Kimbale, Manset, Me. The invention provides a coupling for hose and pipes, which may be quickly operated under all conditions. The coupling members are



COUPLING FOR HOSE AND PIPES

provided with dogs for engaging rims on the companion coupling members, the dogs being operable by curved levers through the instrumentality of garing: the levers are disposed between the rims and the collars when the dogs are in locked position.

Machines and Mechanical Devices

JEWEL AND PIVOT PROTECTOR.—A. J. HOPEWELL, Edinburg, Va. The invention relates to watches, its object is to provide a jewel and pivot protector arranged to absorb slight jars without affecting the central position of the jewels and pivots of a balance wheel, and in case of a severe jar to yield and arrest the momentum of the balance wheel from every direction and to return the jewels and with them the balance staff to their normal central position.

SAFETY DEVICE FOR MACHINERY.—J. B. CAROLIN, care of City Button Works, 374 Second Ave., New York, N. Y. The object is to provide a device for use on foot or power presses and similar machinery, whereby use is made of a lever operating in front of the die or punch and actuated by the latter, in such a manner that it sweeps across the front of the die prior to the punch reaching the work operated on, moves the operator's hands from between the die and the punch thus preventing them from being maimed.

STREET-CLEANER.—P. J. HERTER, 2124 Harrison Ave., Bronx, N. Y. This invention is a manually operated street cleaner, comprising a truck adapted to support a refuse-receiving receptacle, and upright guide on the front of the truck extending a distance above the top of the receptacle, a hand lever with a shovel attached to the forward end provided with a hinged back normally extending upwardly and resting against the guide, the shovel back finally passing over the top of the guide to form a chute for conducting the refuse into the receptacle.

PRINTING PRESS.—H. J. LEACH, care of Mt. Carmel Telephone Co., Mount Carmel, Ill. The invention provides for a printing press especially designed for use by public utilities companies, fraternal orders and others using periodically a large number of bills and the like, it is arranged to simultaneously print the body and stub of business instruments together with the name of the party for whom it is intended, the name appearing on both body and stub and being printed from the same slug.

TURRET ATTACHMENT FOR LATHES.—F. P. MILLER, care of McCroskey Reamer & Co., Meadville, Pa. The object in this patent is to provide a turret attachment arranged to securely hold the tool-carrying member locked in the desired position, to accomplish this use is made of a turret head having tool holding means, a support for the head to turn on and to slide in the direction of the axis of the head, means for raising and lowering the head, and locking means having members of which one is on the turret head and the other on the support, the locking device moving into engagement on lowering the turret head, and moving out on raising it, to allow the latter to be turned.

LOADING AND UNLOADING DEVICE FOR ENDLESS CARRIERS.—C B. HASTINGS, 759 Melrose Ave., Bronx, N. Y. The invention relates to apparatus for soaking and pasteurizing milk bottles and the like, the object is to provide a loading and unloading device for automatically placing the cases filled with bottles into the carrier baskets, closing the covers thereof prior to the baskets entering the tank and finally, removing the cases containing the sterilized bottles from the carrier after leaving the tank.

BLOWER.—A. L. LOEWEN, R. F. D. No. 1, Box 25, Hillsboro, Kans. The invention has for its object to provide a device for use in cleaning grain, wherein a blower, a feeder and a chute are so connected that the feeder may be swung upward into inoperative position or downward into operative position, mechanism is provided for holding the feeder in inoperative position, the feeder being operated from the blower and the connection being such that the raising of the feeder will disconnect the operating mechanism.

MEANS FOR LOCATING AND SECURING SUNKEN VESSELS TO HOISTING APPARATUS.—T. J. CAHILL, General Delivery, New York City. The object of the invention is to provide a simple and inexpensive indicator in the form of a buoy connected to a flexible member, with which are associated means for securing a sunken vessel, the position of which is indicated by the device, to the lifting chains or cable of a hoisting apparatus.

OVERSPEED DEVICE.—R. GUILL and G. L. SHAWVER, Box 155, Charleston, W. Va. The invention has for its object to provide a device for internal combustion engines, and is adapted to be arranged between the carbureter and the intake manifold, and wherein the overspeed device controls the supply of mixture to the engine, and is controlled by the speed of the engine and by the inrush of the mixture.

Railways and Their Accessories

SPRING SUPPORT.—L. E. KEIL, St. Louis, Mo. The invention relates to cars and its object is to provide a spring device arranged to cause the course of the car body to remain in nearly a straight line without up and down motion to insure easy riding in case of unevenness in the track. A further object is to simplify the spring and draft mechanism of the truck to permit convenient removal of worn-out or broken parts. Another object is to provide means which transmits from the car truck to the car body the desired push or pull necessary to cause the car body to move forward or stop from motion with the truck.

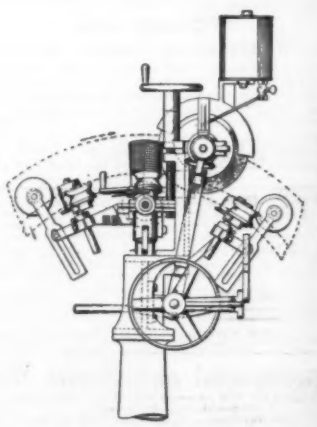
AUTOMATIC STREET INDICATOR.—C. E. PELLETIER, care of A. Wyndham Lewin, 401 Audubon Bldg., New Orleans, La. This invention relates to indicators in connection with railways. The object is to provide an automatic device which will indicate successive streets and stations, also display advertising matter which changes with the change in street. A further object is to provide an indicator which can be reset in any part of the course, and which will reset automatically at the end of its course when starting the course over.

Pertaining to Vehicles

ADJUSTABLE RAY CONTROL.—E. A. MINETTI and B. B. BRIGGS, 42 Elm St., Rutherford, N. J. The patent relates to controlling devices for the rays of light from a lamp, and has for an object the provision of a construction for easily directing the rays from the headlight of an automobile in order to secure any desired illumination and any desired dimming. The object is accomplished by a plurality of pivotally-mounted shutters movably connected by a cross bar and a threaded member for adjusting the shutters and locking them in any desired position.

STORM HOOD FOR VEHICLES.—F. B. HULL, 300 Davis Ave., Harrison, N. J. The invention comprises a peculiar construction of hood forming a wind shield for an automobile to prevent rain or snow from obstructing the vision, through the wind shield, to allow safe and convenient driving, avoid uncomfortable and dangerous drafts, and in the case of storm to give an unobstructed vision.

TIRE SKIVER.—B. E. MAXWELL, 803 N. Lawrence Ave., Wichita, Kans. The invention has particular reference to a machine adapted especially for trimming or skiving off the beads from tires or shoes such as are commonly used on automobiles, motorcycles and other vehicles. The machine includes a pair of feed rollers for



SIDE ELEVATION OF THE MAIN PORTIONS OF THE MACHINE

controlling the movement of the tire, a rotary knife or cutter, a gear device for operating the knife at a certain speed or in a certain defined relation to the rollers. This device makes possible the making of retreads, inside tires, side wall support molds, inner liners, and blow-out patches, out of old, worn or rim-cut tires.

Designs

DESIGN FOR A GAS AND ELECTRIC FIXTURE.—G. WESTPHAL, 73 Madison St., Guttenberg, N. J. This fixture shows a socket cover in the form of a band and has applied thereto motifs of the design, it also embodies shades to which have been applied both motifs and design in bands near the lower and upper end; also a canopy with design shown upon the under surface.

DESIGN FOR A LIQUID FLASK.—H. V. CLAUSEN, 29 Broadway, New York, N. Y. In the figures of the patent papers are shown the side view and a top end view of the flask.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of patentee title of the invention, and date of this paper.

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The Submarine Problem XVI.

(*Concluded from page 233*)

Such a vessel is well adapted to be painted in any suitable way to render it less visible or recognizable at sea. By the use of forced draft a short funnel like that shown, may be employed, and by the use of oil fuel or anthracite coal no smoke will be produced, and the vessel thereby will be made of low visibility at any considerable distance from the periscope of a submarine.

All freight ships now built which may escape being sunk will be needed as freighters after the war is over. Consequently, whatever may be done to render them torpedo-proof should be done with a view to their practical use as freight-ships after the war. In short, a ship should not be made a freak in order to render it torpedo-proof.

In the design of torpedo-proof freight-ship here described, no sacrifice has been made in the carrying capacity of the ship, in its speed, or in its practical suitability as a freighter, except the lack of doors and passage-ways through the bulkheads. However, after the world-war is over, doors and passageways capable of being closed watertight may be cut through some of the bulkheads for convenience in getting about through the ship and in handling freight, or such doors and passage-ways may be placed in the ship from the start; the objection to them is merely the risk of their being unintentionally left open on voyage.

It is of first importance that a torpedo-proof ship should be actually torpedo-proof, and further that it should be adapted to peace-time traffic after the war is over as well as to war-time traffic while the war lasts, and the design here shown is submitted by Mr. Hudson Maxim, with the belief that it meets these requirements.

Ideas That Will Not Work

(*Concluded from page 226*)

It is well recognized in the Council of National Defense that the more we, as a people, are a unit in this war, the more quickly it will be won. It is doubtful if the Council would shut off the flow of suggestions which come to it, if it could. But there is no doubt that the harassed army and navy officers, capable scientists, and learned experimenters who must go over the mass of suggestions offered would welcome a change of heart on the part of the general public, which would cause it to stop sending in half-baked, impossible, impractical, visionary ideas.

Instructing Women In War Work

(*Concluded from page 231*)

driving the more practical if less fashionable tractor.

The point should be emphasized that the girls selected for these tasks are not chosen haphazard. These who are learning to drive trucks are not only strong physically, but if possible are taken from some department of the terminal that has to do with trucking. For example a young woman connected with the department that deals with electrical operation—a stenographer or clerk—is given a chance to learn other work in that department. She may become an assistant to one of the men who wires a building or keeps the lighting system in repair, and after a period of actual practise, she will be ready to do the work independently. Her training as an office employe in that department is helpful in various ways. She knows the names and uses of the materials and tools she works with and has a general familiarity with the subject.

When this knowledge is supplemented by class work that teaches the fundamentals of electricity and actual apprentice work as a helper to an electrician, she develops rapidly into a capable worker. That is an example of the method employed; selection of the right type of woman for the work, followed by theoretical training in class and practise under a regular worker.

Of course a woman taken from the office must be replaced, but it is far easier to break in a new stenographer or clerk than to take an outsider and develop her into a skilled and specialized worker. The foresight shown in working out this plan long in advance is creditable to the executives. When it was known that the draft would take many of their young men, the system of training the women was decided upon and steps were taken to develop the system while plenty of skilled men were available to act as instructors. The apprentice work could in this way extend over a reasonable period, and at times when there was no great press of business the girls could try their hands at actually operating the machines independently.

The women are taking to their new tasks with interest and enthusiasm. Not only the outdoor work, but the classes attract them, and it is believed that they will do efficiently all the unusual work for which they are training.

Is This the Solution of the Portable Motion-Picture Projector Problem?

(*Concluded from page 232*)

at any point on the film in order to project a single view as with the ordinary stereopticon. In transporting the projector the lens, crank and legs are placed inside the case.

The application of motion pictures to commercial life has been discussed many times in these columns; but the peculiar circumstances attending the present European war and its aftermath again bring this subject to the front. Indefinite uses will probably be found for the ideal portable projector, no matter which one it may be, in selling goods abroad in post-bellum days. American salesmen who will invade Europe to sell goods of all sorts will not use samples or models of their goods, especially if they are selling machinery and building supplies and the like. Instead, they will display motion pictures of the huge American factories actually at work turning out the goods, showing every detail of manufacture, and ending with a pictorial demonstration of the goods actually in use by the ultimate consumer. It means the elimination of small working models of locomotives, huge tractors and ponderous machinery of every kind from the salesman's equipment.

An Electric Furnace for Melting Brass

THAT the action of our universities in placing their resources and equipment at the disposal of the government is not entirely a matter of "hot air" has been indicated in more ways than one. Only the other day it came out in the course of our correspondence that the entire staff and equipment of Columbia's Department of Mechanical Engineering is being utilized in connection with the training of Reserve Officers; and now it is announced that through a coöperative agreement between Cornell University and the Bureau of Mines, the electric furnace equipment of the University has been utilized in an investigation, which has occupied several years and is now almost complete, of the electric melting of brass. To the man who can easily remember when the possession by an institution of learning of any such wholly practicable piece of apparatus as an electric furnace would have been regarded as heresy, and who has not been keeping posted upon the trend of the times in academic circles, this may all come with a shock of revelation.

The Cornell experiments are of interest for their own sake in addition to their value as throwing light upon the present outlook of the collegiate mind. The furnaces now used in the brass industry are not particularly satisfactory. They cause a serious loss of metal through vaporization, and they require crucibles, which since the outbreak of the war have become very expensive. It is indicated that the use of a suitable electric furnace might obviate both of these unfortunate features. The Bureau of Mines has actually gotten as far as the working tests of such a furnace, built on the design worked out in the laboratory at Ithaca. This furnace is of commercial size and has been installed in a real, honest-to-goodness, brass foundry, where it is being tried out with special reference to its suitability for use on such brasses as are used for cartridge and shrapnel cases.

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A National Asset in East Tennessee

By F. M. McClenahan

IT has been known for a great many years that the backbone of the iron industry of the South is dependent upon what is technically known as the Clinton-Rockwood formation of fossil iron ore.

This ore was deposited in the Silurian Age of geological history and contains numerous fossil forms that are peculiar to that age. It is an ancient ore, but not so ancient probably as the vast bulk of specular and magnetic ores which seem to have been associated with the igneous origin of rocks. However, the Clinton-Rockwood ore is settled in its mineralization to a large degree, except when it is influenced in the concentration of the iron content by drainage. In the Birmingham region it is generally accepted that the content of the ore is uniform below three hundred feet below the outcrop. On the other hand this type of iron ore is decidely more ancient than limenite or the so-called "bog-ore" which is also of sedimentary origin, but which may have been derived from either the igneous specular ore or the more ancient sedimentary Clinton-Rockwood ore of the Silurian Age.

The outcroppings of the Clinton-Rockwood ore occur at several places along the course of the Appalachians from New York State to Alabama. The importance of the deposit is emphasized by the wonderful development of the iron and steel industry at Birmingham, Ala., and in the general region of Birmingham. Again there are furnaces in southeastern Tennessee, where the proximity of ore and flux and coking coal allow the cheap production of merchant pig iron, which furnaces are located at Chattanooga, Rockwood, Dayton, La Follette, Middlesboro (Ky.) and Johnson City. All these furnaces depend upon the Clinton-Rockwood formation fossil ore as their bulk supply of raw material for iron production with the exception of the last named furnace which uses an ore derived from the igneous rocks.

There are two general divisions of the Silurian iron ore; namely, the oolitic, and the more pronouncedly fossil. The former is made up of small grains compacted together. The cleavage is not regular. The latter is made up of a non-granular adamantine mass, in which are encased numerous forms of fossils both large and small, bivalves, sponges, etc. The non-ferrous material in this latter form may be free silica and free alumina plus varying amounts of carbonate of lime, or it may be free silica with a large quantity of combined silica and alumina plus varying amounts of carbonates of lime and magnesia. The presence of a considerable amount of phosphorus in this ore has been regarded as a handicap to its utilization, especially since the iron content has not shown a percentage above 45 in any very large volume of deposit. However, the fact that the ore in the southern Appalachians is located so favorably to both fuel and flux, the industry has developed, despite its so-called metallurgical shortcoming. Also a large body of this ore has been found to be "self-fluxing." That is to say, although its iron content may drop to 33 per cent, yet within the lump of ore there is contained a sufficient amount of the carbonate of lime to readily smelt the silicious materials together with the aluminous materials naturally occurring also in the ore when the proper amount of coke is added to the furnace charges. The ore has been called "low-grade," yet in reality it is not so low grade as would seem, because of its advantage in being self-fluxing.

About thirty miles due east of Rockwood, Tenn., and about twelve miles from the crest of the Great Smoky Mountains, which separate Tennessee from North Carolina, there occurs a ridge known as the Chilhowee Mountains. The Chilhowees parallel the Great Smoky Mountains for a distance of perhaps thirty miles, traversing Sevier, Blount and a part of Monroe Counties. Their course is northeast and southwest. Close to the Chilhowee Mountains in Blount County, paralleling them on the north, are the Little Pine Mountains.

In conformity with these two parallel systems of ridges are two veins of fossil iron ore that belongs to the typical Silurian fossil deposit. The cleavage is angular. The mass is adamantine where there has not been a well-recognized weathering. The fossils are large and numerous and varied in kind. The iron content is somewhat over 44 per cent. The strike of the veins is extensive. The dip is about forty-five degrees to the horizon. Topographical considerations would lead one to believe the tonnage is enormous. The outcroppings are so regular that there is little doubt of the continuity of the horizontal existence of the veins for miles. The extent of the slope is problematical.

The non-ferrous materials of the ore are approximately as follows: Oxide of alumina (free and combined) 11 per cent; oxide of silicon (mainly combined) 16 per cent; manganese .10 per cent; phosphorus .20 per cent; sulfur .04 per cent. There is little lime present at the outcroppings but quite probably lime and magnesia work into the content of the ore after it passes the level of drainage, with a consequent lowering of the iron per cent content somewhat. But this is entirely problematical as to the extent of the lime content of the vast mass of the ore that lies below the drainage level. There is little evidence of slate partings in the ore.

The location of the ore with reference to its accessibility to railway transportation is such that by an extention of the Louisville and Nashville Railroad from Maryville, a distance of six or seven miles, the veins in both mountains could be readily opened. The grade is an easy one for railroad construction and the several water-gaps in the Little Pine Mountains allow a suitable opportunity for the distribution of spurs from the main extension of the road. Aerial tramways could be used to advantage in transporting ore from the northeastern end of the veins to the Southern Railway at Melrose. A spur from the Tennessee and Carolina Southern division of the Southern Railway could be built from Montvale station to the ore region in the vicinity of Montvale Springs. The distance of ore to railroad is approximately one and one-half miles. The topography favors economic accessibility.

The water-supply of the Little River and the topography of the region adjacent to Melrose Station are such as to offer decided advantage as a site for blast furnaces. About sixteen miles northwest and north-northwest of the ore veins there are the advantages assembled of two competing railroad systems, a navigable river, which is both broad and deep, and a practically inexhaustible supply of limestone and low grade marble for fluxing material in blast-furnace and other furnace work.

Native white and negro population afford an abundant supply of American unskilled and semi-skilled labor at moderate wages.

The best of coking coal is obtainable within 100 miles of the ore veins and very excellent coking coal is obtainable half that distance. The supply is enormous.

Climatic conditions favor 12-month operations. The geographic location of the region, in which the ore occurs, allows an advantage in nearness to northern markets over Birmingham competitors. The navigability of the Tennessee River, to its mouth from some distance above Knoxville, awaits but reasonable national appropriation and engineering enterprise. The opening up of the Tennessee River to navigation from near the Great Smoky Mountains to the Mississippi River would bring the iron and steel products of the Tennessee Valley into a position for active and aggressive competition with similar products transported from the producing centers to Mississippi River points, Gulf Ports, Panama Canal, and beyond.

This national reserve asset awaits consideration and holds out financial reward for its development.

These ores are being investigated from the view point of economics and metallurgy at the Mellon Institute of Industrial Research, University of Pittsburgh.

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Dated October 6th, 1917, the special Aviation Number will be devoted almost entirely to things aeronautical. Among the special features will be a full-page chart showing all the leading American aircraft—aeroplanes, seaplanes, dirigibles and kite-balloons. In an article entitled, Aviation Engine Development, a well-known authority on internal combustion engines will give a brief exposition of the leading aviation engine forms that have received practical application in successful aircraft. There will be an article on what is to be seen at an American flying school; another on a British airman's experience during the past three years of aerial warfare; and still another on the manufacture of aircraft. There will be a chart on the United States air service insignia. The classification of military aeroplanes will be discussed at length, and there will be numerous photographs of the very latest in European fighting-planes. In sum, this special Aviation Number will be a compendium of military aviation to date.

Read the SCIENTIFIC AMERICAN *for October 6th—then read it every week for practical information in the fields of Science, Mechanics, Inventions and Industries*

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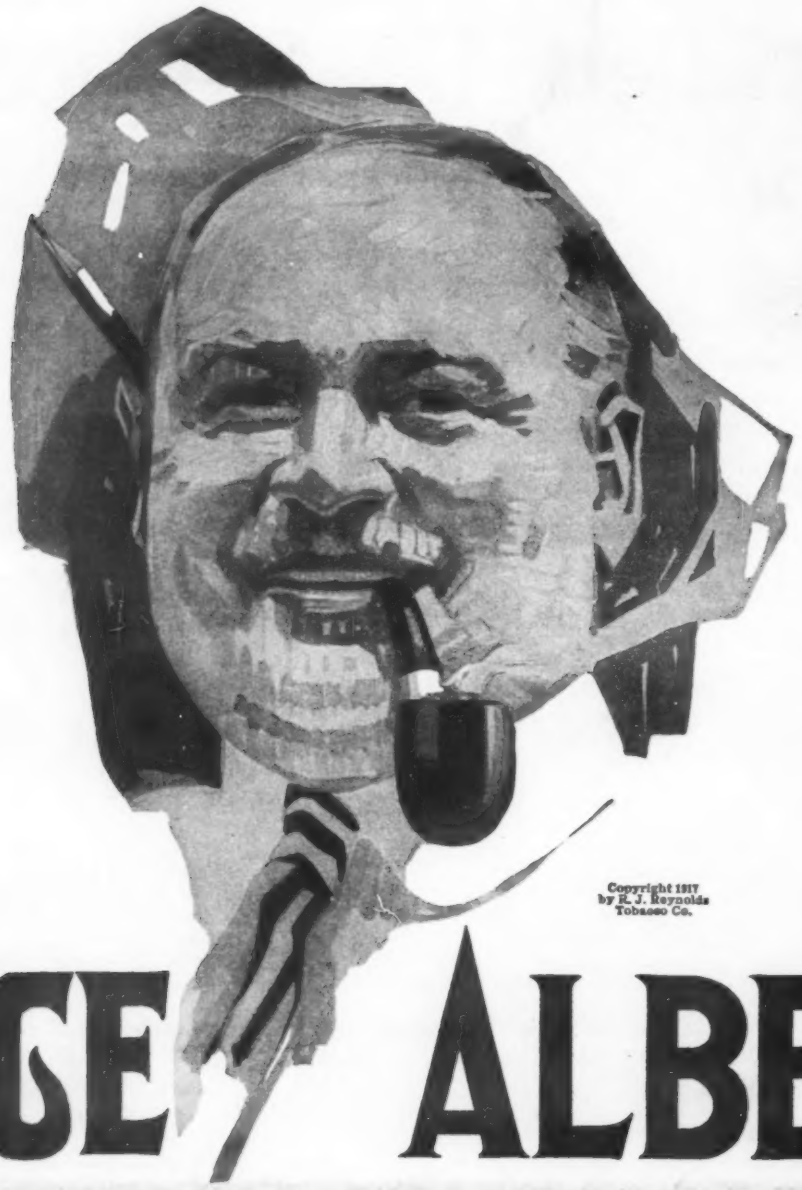

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Tobacco Co.

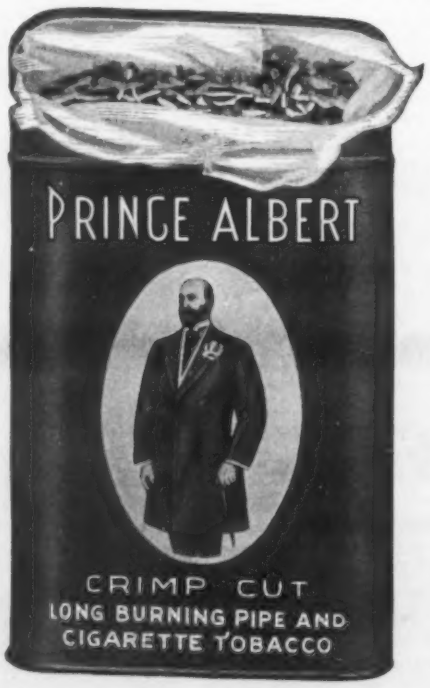
PRINCE ALBERT

the national joy smoke

YOU'LL brighten up your smokefuture close to double its present gait if you'll be a sport-for-a-spell and let Prince Albert tell your taste and tongue a tobacco tale that you'll hear today in any port on the Seven Seas. You can't figure out any quantity of smokejoy that P. A. fails to furnish; you can "sit-in" and puff away till the birds start to chirp without a tongue-tingle, without a comeback of any sort! *And that P. A. flavor!*

For Prince Albert has the quality that certainly hands out satisfaction with a capital S—and, *it's quality you're on the trail of,* not coupons, premiums or gifts!

Start patting yourself on the back as speedy as you find yourself on the way for a supply of P. A., for, you're headed for smokesunshine, for more jimmy pipe joy or more makin's joy than you ever believed could be yours! Sound-the-cymbals and run up the colors, for you'll want to celebrate, ***surest thing you know!*** With P. A. for "packing" you get a new slant at smoke-sport that makes it all the more alluring. And, you just bang away on your pipe or hustle to roll 'em like every day was a holiday! Keeps your smokeappetite tuned to party-pitch to beat the band!



Everywhere tobacco is sold you buy Prince Albert. In toppy red bags and tidy red tins. Then, there are handsome pound and half-pound tin humidors—and—that clever, practical pound crystal-glass humidor with sponge-moistener top that keeps the tobacco in such fine condition.

And, Prince Albert can't any more bite your tongue or parch your throat than a new baby can whistle for spuds. That's because bite and parch are cut out by our exclusive patented process. You can go-the-limit at both ends against the middle and little old P. A. will hand-out-joy to the high-top-point of your keenest desires!

Your cue is to get busy on the job and get some of that Prince Albert flavor and fragrance into your smoke-system. It's so enticingly delightful you'll agree that if you haven't been smoking it you've been camping on the wrong side of the fence! And you can lay-a-bet on ***that*** fact!

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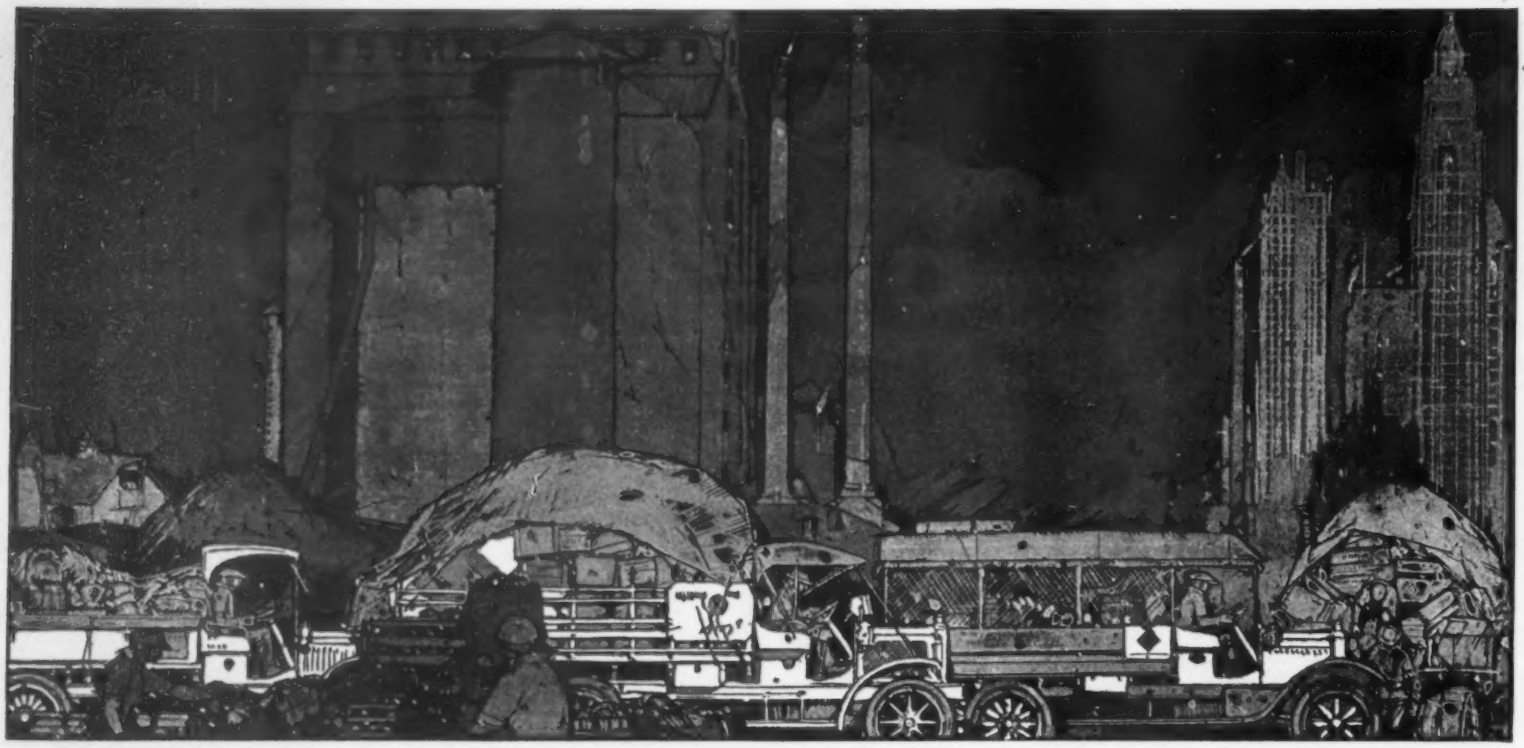
SCIENTIFIC AMERICAN

WHEN THE WINGED CAVALRY CHARGES THE ENEMY'S LINE—[See page 245]

October 6, 1917

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents



PROTECT *your* BUSINESS *now* *against* LOSS *of* MAN POWER

THE most serious problem confronting business today is shortage of labor. Millions of young men may be called to the colors. Other millions will be needed to produce munitions and material of war. Immigration has stopped. ***Many concerns may run short of necessary labor, unless they take steps to protect themselves now.***

Big Business is farsighted. It is installing and utilizing to the utmost every mechanical device which will take the place of horses and men. In delivery service motor trucks do the work.

It is the small business man, manufacturer or merchant who may be caught napping when the "help" crisis comes. If he still employs teams and drivers he may find his business seriously hampered.

The concern which employs two or more vehicles for delivery service may be menacing its future if it does not use trucks.

All business is entering upon a period of war stress and strain. Profits will be lower and volume much higher. The former will be taxed; the latter is always a war time condition. It is so in England; it will be so in this country. The efficiency, speed, steadiness and economy of mechanical power and transportation must supplement or supplant the human factor.

WHITE TRUCKS

Wherever efficiency, speed, steadiness and economy are most needed, White Trucks are to be found. Their predominant use by Big Business is well known. Where standardized cost records are kept, White Trucks are purchased increasingly. Their long life, low maintenance and steady operation show unmistakably in figures. The harder the work and the heavier the going, the more marked is this showing.

The White Company has had broad experience in truck installation and in the problems of transport, for big operations and for little operations. Our service and counsel are yours for the asking, without cost or obligation on your part. We never urge an installation which does not promise profit to the owner.

THE WHITE COMPANY
CLEVELAND

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First Aide to Aviation

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Repair parts, fuel, labor must be mobilized with clock-like certainty. The lives of highly trained men and the most vital issues hinge upon each unit doing promptly and perfectly the duties placed upon it. Trucks must meet regular routine unfailingly and still be equal to emergency demands.

Federal 100% All-truck construction makes the Federal ideal for the most severe of field requirements. For eight years, Federals have demonstrated their stamina, day in and out under the hardest conditions.

Federals built for one purpose only—the maximum of service—they stand for "Performance" wherever trucks are used.

One to Five Ton Capacities.

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Converted by French army engineers into a mechanical mole, it is scooping out communication trenches on the western front with an endless chain of buckets drawn by its sturdy power.

The War-cross is not given to motor trucks. But the choice of a relatively light Packard for such heavy duty work is evidence of a reputation for strength and dependable power earned by exceptional service under exacting conditions.

Silent, chainless Packards are built in seven sizes—1 ton to 6½ tons—the *economical* truck for every hauling task that any business has.

Four-speed transmission on all models. The extra low gear gives irresistible pulling power for difficult starts and heavy roads. It also makes important savings on gasoline, on tires and on maintenance expense. Call the nearest dealer or write Packard Motor Car Company, Detroit. *Ask the man who owns one.*

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